

SR 520

**PONTOON CONSTRUCTION DESIGN-
BUILD PROJECT**

**Operations and Maintenance Manual
(RFP 2.12.5.4)**

May 2015

This manual was compiled in accordance with the Request for Proposal (RFP) section 2.12.5.4. It contains information on the operations and maintenance of the Aberdeen, Washington Pontoon Casting Facility (PCF) and was compiled by Kiewit-General (KG) in March of 2015 for the Washington State Department of Transportation (WSDOT). The manual is organized into four primary sections: Pontoon Casting Facilities, Drainage Facilities, Electrical and Control Systems, and Appendices. The manual's contents were dictated by the RFP and the appendices, where not explicitly referenced, were included to assist in the successful operation of the PCF.

The Pontoon Casting Facility section (RFP 2.13.6.4) includes details on flooding and dewatering the basin, installation and removal of the gate system, and design criteria for the basin and the Hydraulic Control Structure. Appendices linked to this section include the Fish Handling Plan (Appendix D), and a plan for installation and removal of the gate system (Appendix M). These plans have been included for reference purposes only.

The Drainage Facilities section (RFP 2.17.6.8) contains information about water conveyance throughout the site, storm water best management practices, and owner's manuals for the various pumps and flow control devices that are on site. In addition to water systems, this section also addresses environmental permitting requirements for operation of the PCF.

The Electrical and Controls Systems section (RFP 2.19.5.6) contains materials related to the electrical layout and operation of the site. This includes electrical as-built drawings of the permanent power lines throughout the PCF, owner's manuals of the site's electrical components. The only appendix specifically linked to this section is the Power Study (Appendix L). This report, compiled in June of 2011 by HNTB, assessed the reliability and nature of the power supply from the city of Aberdeen to the site.

Beyond the information specifically required by the RFP, the appendices include the full geotechnical report with supplemental site conditions and loading reports from Shannon & Wilson (Appendix F), A sedimentation study of the launch channel (appendix G), a site component maintenance schedule (Appendix J), and a digital storm water management calculator (Appendix K). These appendices, as well as those mentioned in reference to the main document sections, have been included to assist the future owner with the successful operation and maintenance of the PCF.

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OPERATIONS AND MAINTENANCE MANUAL (RFP 2.12.5.4)

1. Operation and Maintenance of Systems and Equipment

1.1. Pontoon Casting Facilities (RFP 2.13.6.4)

1.1.1. Casting Basin Operation Plan

Piezometers shall be monitored prior to, during, and after dewatering of the basin to confirm values are returning to baseline values. Baseline values are to be considered the values monitored prior to flooding the basin. See the Geotechnical Report in Appendix F for piezometer monitoring locations.

A. Sequence for Flooding Basin

- a) Choose appropriate tide for float out

Float out tide must be of sufficient height to float the deepest draft pontoon with 1 ft minimum clearance between the slab and the pontoon. Tide must also be of sufficient height for long enough to float out all pontoons that have lifted off the casting basin floor. Casting basin gate is estimated to take approximately 3 hours to remove.

- b) Determine appropriate time to open sluice gates

The opening of the sluice gates should be timed such that the water surface in the casting basin and the water surface in the launch channel equilibrate at the low water slack tide preceding the float out tide. This is most easily achieved by opening the sluice gates on the falling tide directly preceding the float out tide.

In no case shall the casting basin operator operate the sluice gates in such a manner as to allow the water elevation within the casting basin to exceed the water level within the launch channel. The basin gate is never to have a net hydrostatic pressure forcing the gate into the launch channel.

The point at which the sluice gate should be opened will vary for each float out due to different tides and types of pontoons to be floated out for each pontoon construction cycle.

Casting basin operator shall determine the approximate filling time for each float by calculating the volume of water needed for each float out based upon the as-built casting volume and the volume displaced by structures being floated out. 100 cfs per intake pipe should be used as the casting basin filling rate for the first float out. Measured allowable filling rate shall be used for all subsequent float outs.

c) Clean casting basin

Prior to flooding the casting basin, the basin operator shall clean the floor and walls of the casting basin sufficiently to prevent delivery of contaminants to the waters of Grays Harbor.

Wash water shall be directed to the process water collection system. The process water system shall be pumped completely dry after washing the basin. The sumps and pump chambers shall be shut off, and the system shall be charged with clean or treated water. System must be charged prior to casting basin flooding. See Process Water System section of the Manual for complete operating procedures.

d) Groundwater System

The groundwater system shall be turned off prior to flooding the casting basin and the sumps shall be checked to make sure they are charged with water. See Groundwater Dewatering System section of this Manual for complete operating procedures for the groundwater system.

e) Place fish Exclusion measures

Ensure all stormwater/process water collection openings have the appropriate fish exclusion measures in place. Ensure all groundwater pressure relief valve openings have the appropriate fish exclusion measures in place. Appropriate fish exclusion measures are those that prevent the entrapment of fish within the openings. For example, casting basin floor drains should be covered to prevent fish from entering, but should allow water to drain through. Filter fabric may be used, secured in place by tightly wrapping the fabric around the drain grate, with the fabric laid flat on the top side of the grate. Alternatively, aluminum screening material may also be used instead of filter fabric. The large drain grate opening over the basin sump pump at the north end should also be covered with either filter fabric or aluminum screening. Gaps between the covered drain grates and drain perimeter should be filled to prevent any fish from entering the drain. The filter fabric or aluminum screens should be installed securely to avoid being blown out or torn off during basin flooding or dewatering.



Filter Fabric wrapped over floor drain grate in casting basin



Aluminum screen wrapped over floor drain grate in casting basin

At the HCS pumps housing fish screen, the gaps between the screen and adjoining surfaces should be filled to prevent fish from entering. Also, gaps between the housing and adjoining concrete surfaces should be filled.



Remove intake pipe blind flange covers prior to placing intake fish screen box. Covers will have a small valve on their face for equalizing pressures inside and outside of the pipe. Once valve has been opened and pressure equalized, the covers may be unbolted, removed and stored upland until required to be placed on the pipes again.

Place intake fish screen box on intake pipes. Verify that intake pipes mounted to the bulkhead wall have mated correctly with the pipe stubs on the intake fish screen box. When mated correctly pipes shall be aligned and flanges shall be resting one atop the other as indicated on as-built drawing HS16 in Appendix B. A neoprene gasket shall be used to 'close' any gaps between the flanges.

Fish collection box aeration system should be readily available and in working order prior to placing box on casting basin. Place fish collection box in provided location on the casting basin floor. See as-built drawing HS2 in Appendix B for location. Airstones, bubblers or aeration devices should be installed securely in fish collection box. Oxygen cylinders need not be in place in the fish box until fish handling has begun. Working order shall be defined as being capable of maintaining the dissolved oxygen level in the fish collection box at 5-7 ppm for a minimum of 10 minutes as long as fish are still present.

f) Open sluice gates

Allowable sluice gate openings vary with the tide. Openings shall be controlled such that the approach velocity across the intake fish screen is maintained at or less than 0.4 fps.

Recommended Initial Sluice Gate Opening*

Tide Elevation ft	Sluice Gate Opening in	Sluice Gate Opening ft
+13.86	18.04	1.50
+13.00	18.51	1.54
+12.00	18.74	1.56
+11.00	18.98	1.58
+10.00	19.45	1.62
+9.00	19.92	1.66
+8.00	20.16	1.68
+7.00	20.63	1.72
+6.00	21.11	1.76
+5.00	21.82	1.82
+4.00	22.30	1.86
+3.00	23.02	1.92
+2.00	23.98	2.00
+1.00	24.94	2.08
0.00	25.90	2.16
-1.00	27.09	2.26
-2.00	28.75	2.40
-3.00	30.61	2.55
-3.35	31.53	2.63

* Openings are recommendations only. Actual openings must be verified and possibly adjusted based upon flow velocity data obtained in the field by using flow velocity monitoring equipment. In no case shall the velocity across the intake fish screen exceed 0.4 fps. These openings are approximated for a 100 cfs flow per pipe.

g) Allow casting basin to fill through sluice gates

Sluice gate openings shall be monitored and adjusted throughout fill cycle. It is acceptable that the gates be further opened as the filling of the basin progresses to maintain the maximum allowable flow rate. In no case shall the opening cause a violation of the prescribed maximum approach velocity at the intake fish screen of 0.4 fps.

Once water surface within the casting basin has equilibrated with the water surface in the launch channel removal of the basin gate may be initiated.

Sluice gates must be closed prior to allowing any water to enter the basin through the basin gate opening to ensure no fish can become trapped within the sluice gate piping or within the intake fish screen box.

h) Remove basin gate

See Gate as Complete System section of O&M Manual for gate removal and stowing procedures.

i) Remove intake fish screen

Once sluice gates are closed the intake fish screen can be removed, cleaned and stowed. This step does not need to be completed at this point in time, but may depending on casting basin operator's preferences.

Intake fish screen shall be lifted off of its monopole mount and moved to a designated upland area. The intake fish screen shall be inspected for live fish after being set upland. Intake fish screen shall be washed with fresh water and any debris removed. Screen shall be inspected for any damage that may cause permit violations, such as dents that may cause the screen openings to exceed the maximum allowable opening size. Screen shall also be inspected for any damage that may cause mounting issues for the next float out. All damage shall be repaired as necessary.

Intake fish screen shall be stowed upland until needed.

Upon removal of the intake fish screen, blind flange pipe covers are installed on both intake pipes. Covers are bolted to the existing intake pipe flanges to prevent fish or debris from entering the pipes when not protected by the intake fish screen. Covers also allow for the maintenance of the sluice gates.

j) Allow casting basin to continue to fill through casting basin gate opening.

Float out may begin as soon as structures have lifted off of the casting basin floor and sufficient clear space between the structure bottom and the casting basin slab has been achieved.

k) Float out

Float out plans and methods shall be developed by the casting basin operator or by a designee of the operator.

B. Sequence for Draining Casting Basin

a) Float out is complete

All pontoons required to be removed from the casting basin have been removed.

b) Allow casting basin to drain through casting basin gate opening

Casting basin shall be allowed to drain through the casting basin gate opening as the tide falls.

c) Place casting basin gate sections

Casting basin gate sections should be placed at or near low water. See Gate as Complete System section of O&M Manual for gate assembly procedures.

d) Place Hydraulic Control Structure Pumps

This procedure may be completed at any point in the float out cycle.

Pumps shall be lowered into the pump riser casing until pump has landed on the concrete casting basin slab pump sump. Discharge piping must be attached to the pump prior to lowering the pumps into place if fish are present in the casting basin. If fish are not present and the casting basin water level is low enough, personnel may enter the pump screen shed to make the piping connection.

Pumps specified for SR 520 PCF are to rest on a solid surface. No mounting hardware is required. If casting basin operator chooses a different pump style these procedures must be re-examined to determine the appropriate procedure for the pump chosen.

Connect pump discharge piping to the discharge piping located on the top of the bulkhead wall. See as-built drawing HS5 in Appendix B for location of connection.

Connect power to pumps. See as-built drawing UP03 in Appendix B.

e) Groundwater System

The groundwater system shall remain turned off until the water level in the casting basin is below the top of the casting basin side wall. See the Groundwater Dewatering System section of this Manual for complete operating procedures for the groundwater system.

f) Pump water level in casting basin down to prescribed fish handling level

Pumps may be turned on once casting basin gate sections have been placed and are secure.

Velocity across fish screen shed shall not exceed 0.4 fps. Similar to flooding, the flow velocity must be verified with flow monitoring equipment. Pumps may need to be shut off as fish screen is exposed due to the falling water level in the casting basin. It is expected that the velocity across the fish screen will exceed 0.4 fps once the water level in the basin falls below elevation -5.5 ft (3.5 ft deep). If fish are present then one of the center pumps should be shut off. Pumping may continue. The other center pump may also need to be shut off if fish handling takes place below elevation -6.25 ft (2.75 ft deep). The next pump off will occur at elevation -6.8 ft (2.20 ft deep) if fish are still present within the basin. The shut off points for the basin pumps listed are approximate

and are provided for guidance only. Velocities should be monitored in the field and pumps operated according to the measured velocities.

All pumps shall be turned off once the water level in the casting basin reaches the prescribed level for fish handling. Minimum allowable depth of water for which seining is allowed is 24 inches.

g) Fish handling

See SR520 Pontoon Construction Design-Build Project Fish Handling plan in Appendix D for additional information on fish handling procedures.

Fish collection box with aeration system has been provided to move fish from the casting basin to the launch channel. As-built drawings HS20 – HS23 in Appendix B provide details of the collection box.

h) Pump out remaining water in casting basin

Casting basin operator may pump out all remaining water in the casting basin once fish handling is complete. Approach velocity and other fish protection measures do not apply if all fish have been removed.

All fish exclusion measures protecting stormwater/process water collection openings shall be removed upon completion of draining the casting basin. The sump pit for dewatering pumps shall be inspected to ensure there are no live fish trapped within it. Care should be taken to ensure all miscellaneous debris such as seaweed are removed from the openings and removed from the casting basin floor. Catch basins and sumps shall also be inspected for debris. All debris must be removed prior to restarting the process water system. See Process Water System section of this document for complete operating procedures.

i) Remove and stow Hydraulic Control Structure pumps, discharge piping and fish screen panels

Pumps shall be disconnected from power and from the discharge piping mounted to the bulkhead wall.

Pumps and discharge piping connected to the pumps may be lifted out through the riser casings and moved upland for cleaning and stowage. All pumps and piping to be stowed shall be washed thoroughly with fresh water prior to storage.

Fish screen panels may be removed from the shed assembly and lifted out of the basin to be washed down with fresh water and stowed upland. Screens should be inspected once clean for any damage that may cause permit violations or impair the ability of the basin operator to reinstall in the shed assembly.

Pumps, piping and screen panels shall be stowed upland in a secure location until needed.

A significant amount of sediment is deposited on the basin floor during the flooding process. In order for the facility to be fully operational the sediment must be removed after draining.

C. Sluice Gate Information

QUICK REFERENCE

TYPE	MODEL	DETAIL	STANDARD SIZE RANGE (INCHES)	MAXIMUM NORMAL (FEET)		GENERAL USE					
				SEATING (FACE)	UNSEATING (BACK)	SEWAGE TREATMENT	WATER TREATMENT	FLOOD CONTROL	IRRIGATION	INDUSTRIAL	HYDRO POWER
HEAVY DUTY SLUICE GATES	Series 7000, 5000 and 4000	SQUARE	6 X 6 to 144 x 144 **	55 to 200 Varies with Size	10 to 75 Varies with Size	X	X	X	X	X	X
		RECTANGULAR	12 X 18 to 120 x 180 **			X	X	X	X	X	X
		ROUND	6 to 144 **			X	X	X	X	X	X
		SELF-CONTAINED	120 wide **			X	X	X	X	X	X
	Model P-32	ROUND SELF-CONTAINED	6 to 14	60	20	X	X	X	X	X	

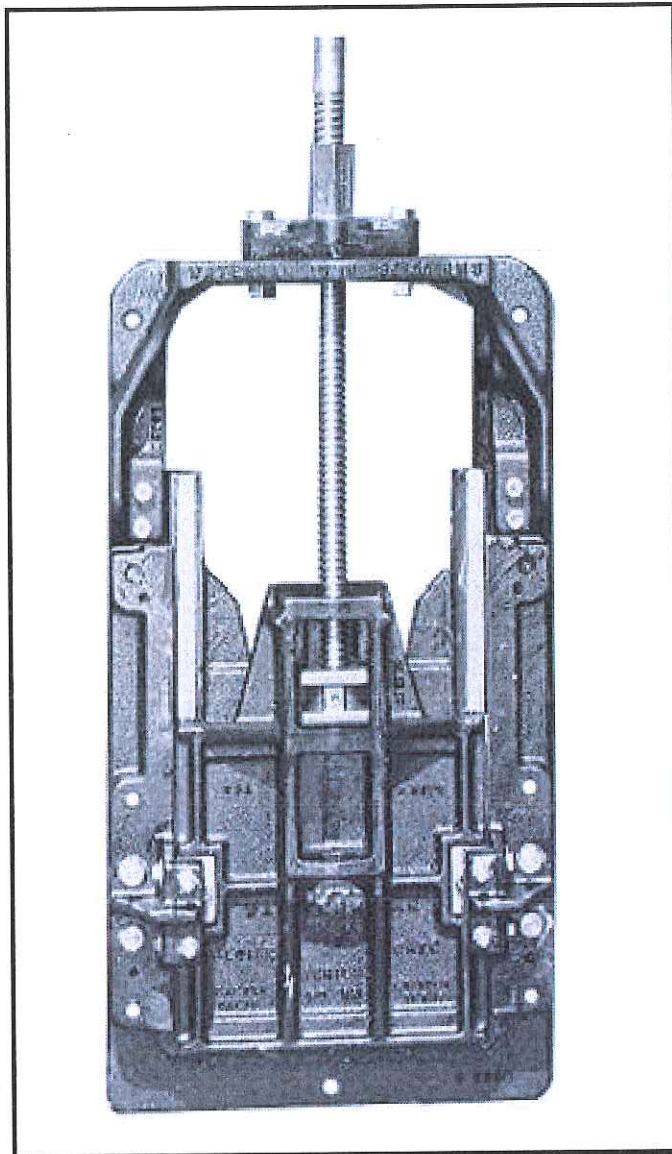
** INDICATES COMMON SIZES, OTHER LARGER SIZES ALSO AVILABLE.

*** INDICATES STANDARD DESIGN, SPECIAL DESIGNS FOR HIGHER HEADS AVAILALBE.

Key to Waterman Sluice Gate Terminology

Prefix	Series	Suffix
Q = Flush Bottom Seal	7000	f = Standard Flangeback
S = Sluice Gate	5000	ff = Extended Flangeback
C = Circular Opening	4000	NRS = Non-Rising Stem
		Y = Self-Contained Frame (yoke)
		X = Special Modifications
		I = Inverted (downward opening)

Example: S-5000-f-NRS-Y
Sluice Gate with Standard Flange Back, Non-Rising Stem,
Self-Contained Gate



HEAVY DUTY, CAST IRON

SERIES 5000 AND 7000 SLUICE GATES

GENERAL DESCRIPTION

Waterman Series 7000, 5000, 4000 and P-32 Heavy Duty Sluice Gates are designed and manufactured to meet or exceed AWWA Specifications C-501 (latest revision).

USES

Waterman Heavy Duty Sluice Gates have been successfully used in a wide variety of applications, including municipal water works and treatment facilities, flood control projects, reservoirs and fish hatcheries.

FEATURES

Gate shapes include square or rectangular with square, rectangular or circular opening, and can be furnished with standard flangeback or extended flangeback frames.

All units feature adjustable corrosion-resistant side wedges and corrosion-resistant malleable seat facings locked in dovetail grooves. All mating or sliding surfaces are fully machined including close tolerance tongue and groove guides. All assembly hardware is of corrosion-resistant material.

OPTIONAL FEATURES

Optional features available include Non-Rising Stem Adaptors, Flush Bottom Closures, Downward Opening Units, Top and Bottom Corrosion Resistant Adjustable Wedges, and fully Self-Contained Gates with extended guide rails, cast iron yoke, stem and lift.

SEATING AND UNSEATING HEADS

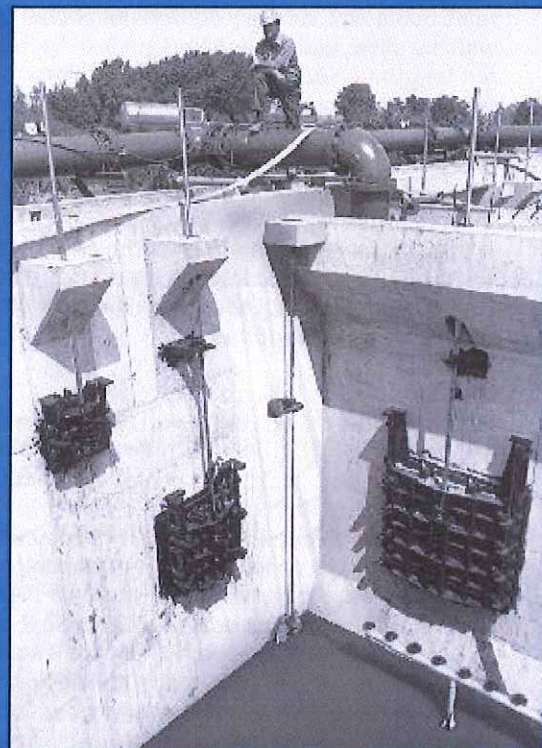
The basic design of these gates provides adequate safety with good sealing characteristics for seating and unseating heads as follows:

SERIES	Seating Heads, Feet (1)	Unseating Heads, Feet (2)
5000	55 to 200 (varies with size)	10 to 150 or higher (varies with size)
7000		

(1) Heads are measured from the horizontal center line of the gate opening to the surface of the water. With SEATING HEADS (or face pressure), the water is on the front of the gate and helps to press the seating surfaces together.

(2) With UNSEATING HEADS, the water is on the back of the gate and tends to push the slide away from the frame. Top and bottom wedges are usually necessary to overcome this back pressure. Structures for sluice gates should be designed so that the gate is subject to seating pressure whenever possible. For unseating heads top and bottom wedges are used on all gates having a width of 24" or more, except that gates with flush bottom seats have top wedges only.

Continued on next page.



HEAVY DUTY, CAST IRON

SERIES 5000 AND 7000 SLUICE GATES

GENERAL DESCRIPTION (continued)

FRAMES

The cast iron frames are square or rectangular in shape, of one piece construction and may have square, rectangular, or circular openings. Standard Flangeback, Rectangular Extended Flangeback and Circular Extended Flangeback types are available.

GUIDE RAILS AND WEDGES

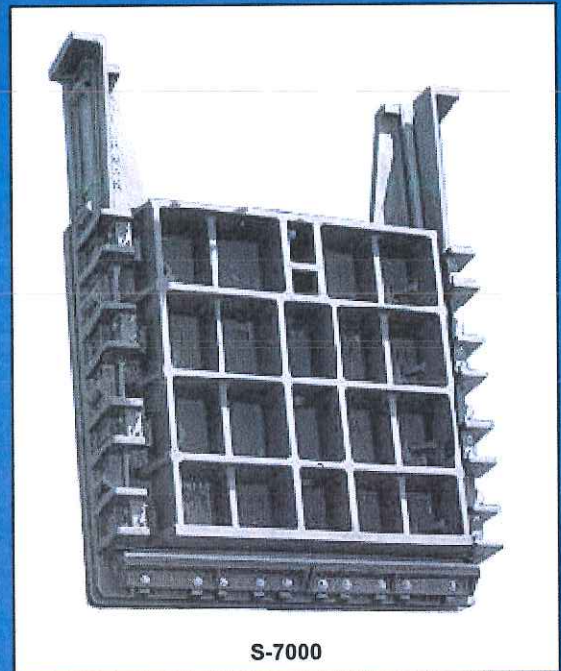
Cast iron guide rails of a length sufficient to support at least one-half of the slide when fully opened are cast integrally with the frame on small and medium size gates and are mounted on fully machined surfaces with dowels and corrosion resistant fasteners on the larger sizes. Wedge block pads are cast as a part of the guide rails and reinforced with heavy ribs. The wedge seal faces or adjustable wedge blocks are attached to these. A fully machined groove to receive the slide tongue extends the full length of each guide. Guides are extra heavy and reinforced for their full length to assure maximum rigidity against wedging pressure and unseating heads when the slide is partially open.

SLIDE

The cast iron Slide (Cover) has vertical and horizontal reinforcing ribs, a heavy square nut pocket cast integrally with the slide, and a machined guide tongue extending the full length of each side. Minimum tolerances are maintained between the slide tongue and guide grooves to provide maximum stability of the slide in partially open positions, thus minimizing chatter. Gates with Non-Rising Stems are furnished with a special slide having a heavy thrust nut pocket cast integrally with the slide. This pocket is located above the opening of the gate so that at no time will the stem protrude into the waterway. The thrust nut in the slide pocket is not secured to the stem and acts as a lift nut as the stem is rotated.

SEATS

Seating faces are of a corrosion resistant material and are secured in full width dovetail grooves machined in the cast iron frame and slide (see material schedule for alloys available). Seat facings are of a work hardening malleable type and are deformed and locked into place in the grooves without the use of fasteners. An accurate and positive attachment is obtained with the grooves completely filled. The full width dovetail design eliminates the possibility of leakage between the corrosion resistant seat material and the castings. The full width dovetail design of the seating faces prevents damage to these faces which may occur in dovetail designs having overhangs which may work loose during normal operation of the gate. (See detail drawing)

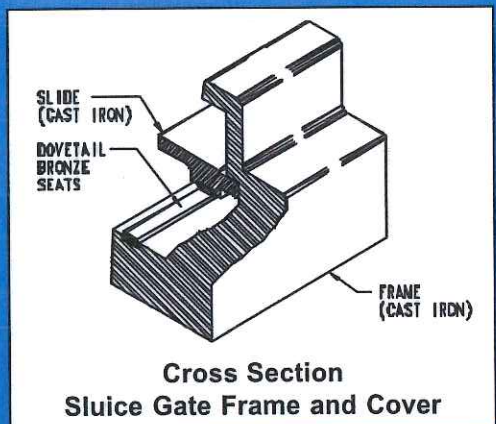


S-7000

JOBSITE HANDLING AND INSTALLATION

To assure proper operation of our gates, care must be taken in the receiving, handling, and storage of all gates and appurtenances. Installation must be accurately performed. See the Waterman Heavy Duty Sluice Gate Installation Manual for complete detailed instructions.

Waterman Heavy Duty Sluice Gates are completely assembled in the plant and are given an AWWA C-501 inspection by qualified inspectors before shipment. This includes operational, visual and feeler gauge tests. Seat clearance must not pass a .004 gauge. When required, a hydrostatic test can be performed before shipment at an extra charge. Waterman gates, properly handled, stored and installed should meet these same standards in operation.

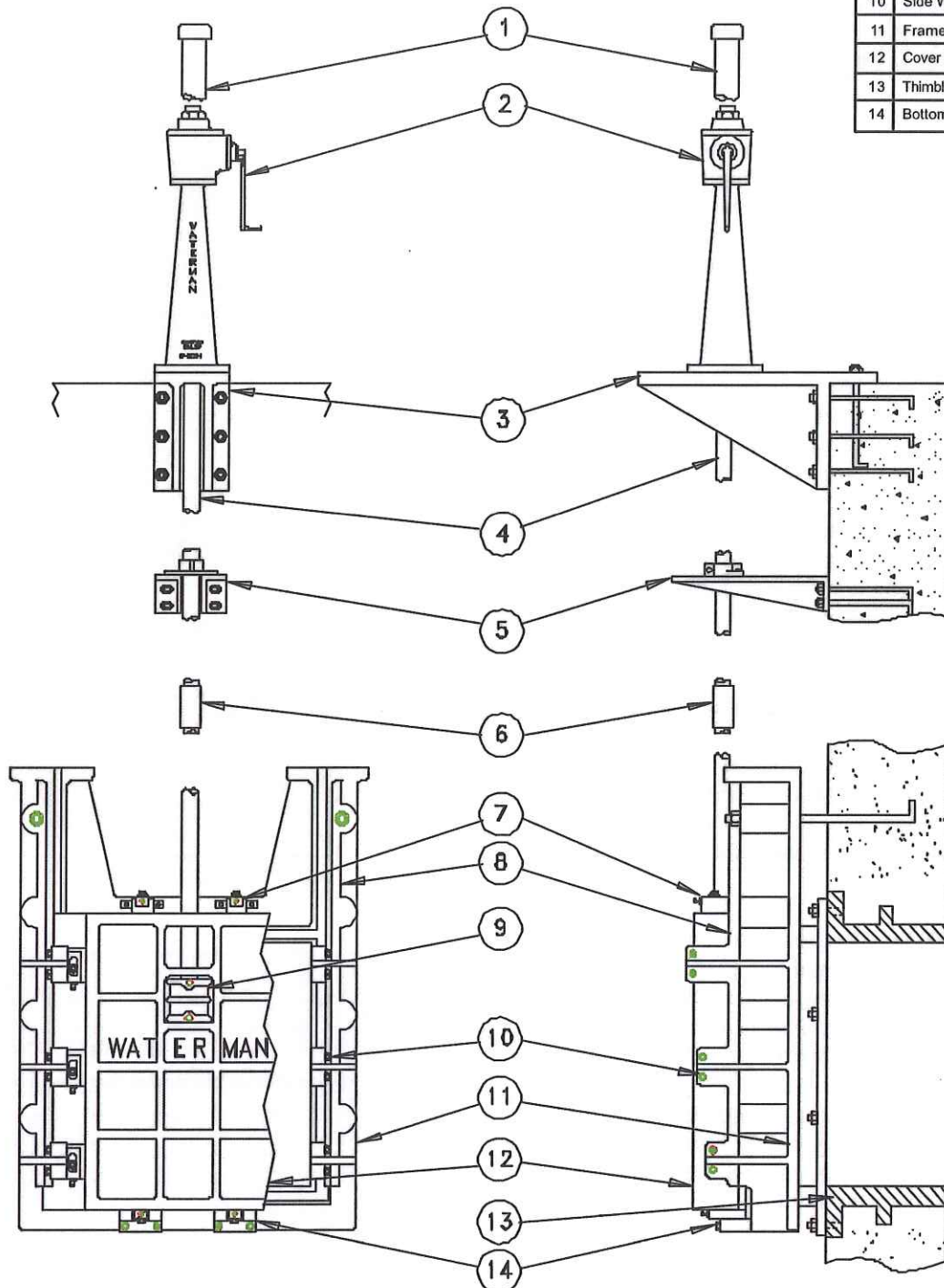


Cross Section
Sluice Gate Frame and Cover

HEAVY DUTY, CAST IRON

SERIES 5000 AND 7000 SLUICE GATES

PARTS IDENTIFICATION	
No.	Name
1	Stem Cover
2	Gate Operator (Lift)
3	Top Wall Mounting Bracket
4	Stem
5	Stem Guide
6	Stem Coupling
7	Top Wedge
8	Cover Guide Rail
9	Thrust Nut
10	Side Wedge
11	Frame
12	Cover (Slide)
13	Thimble
14	Bottom Wedge



SELF-CONTAINED SERIES 5000 AND 7000 SLUICE GATES

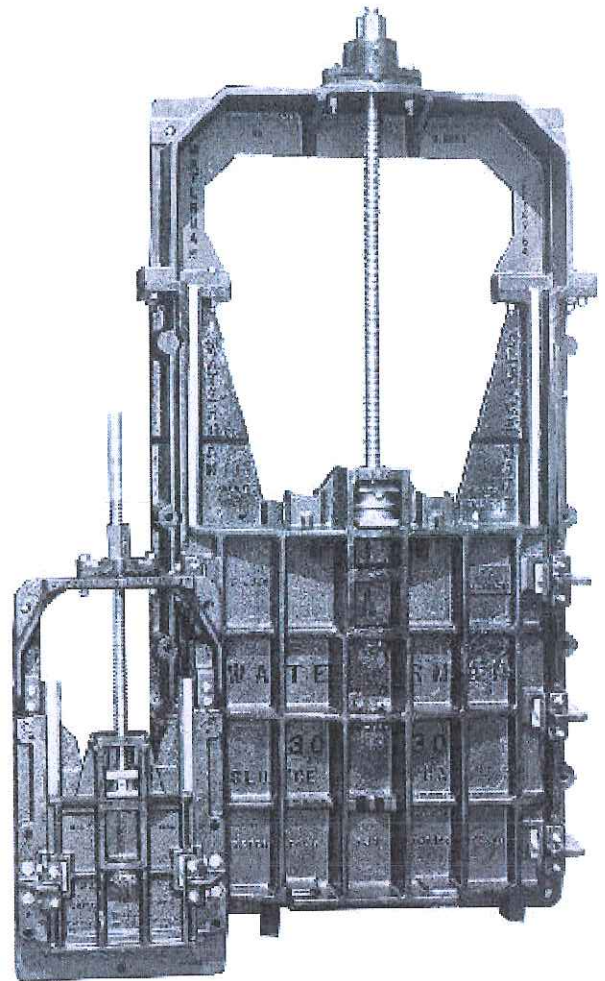
Self-contained gates are used when space above the gate installation, or the absence of structural supports, limits the installation of an independent operator.

Waterman self-contained gates are available in sizes up to 84" x 84" with standard cast yokes, and larger sizes with heavy duty fabricated yokes. Heavy duty cast iron yokes are attached to the machined pads on the gate guides. An extension of the guide provides clearance for the slide to move to the completely open position. A machined pad on the yoke provides a true surface for mounting the thrust collar or lift.

Self-contained gates may be furnished with rising stems, in which case the stem is secured to a standard slide thrust nut in the normal manner, and operated by a corrosion resistant stem and standard handwheel or crank type lift. The thrust of opening and closing is transmitted directly through the lift and yoke to the gate. Self-contained gates with non-rising stems utilize the non-rising stem (NRS) type cover arrangement and a stem having a thrust collar, contained in a housing on the yoke. Rotating the stem causes the stem block and slide to travel up and down. The operating thrust is transmitted directly to the yoke and gate frame.

Ball bearing lifts are not recommended for mounting on top of a self-contained yoke where the lift would be subject to submergence in the liquid being controlled. Special self-contained units with hydraulic cylinder operators or motorized lifts are available.

Non-Rising stems are not recommended for use in fluids with heavy slurry concentrations as threaded portions of stem may be submerged. Premature wear may result.



ADJUSTABLE

WEDGE SYSTEMS

There are two types of Waterman wedging systems, "B", and "B-1".

Type "B-1" wedges are always provided on Waterman computer-controlled machined sluice gates up to 48" in width. Type "B" wedges can be provided for all other Waterman heavy duty sluice gates.

TYPE "B" WEDGE SYSTEM

The "B" system has been designed to meet those specifications wherein the adjustable portion of the wedge must be on the slide. The wedge block facing surface is securely attached to the reinforced overhanging guide wedge block, double-bolted in shear and pinned to prevent movement. (This design allows for easy replacement of wedges in the field.)

The adjustable solid one-piece wedge operates on a machined tongue-and-groove surface, and is locked in place with a corrosion-resistant stud and adjusting bolt with lock nut.

TYPE "B-1" WEDGE SYSTEM

The "B-1" wedging system is designed for unit compatibility with all of Waterman's computer-controlled machined sluice gate surfaces on gates up to 48" in width. The "B-1" wedge, also with computer-controlled machined surfaces, assures optimum mating of wedge and gate surfaces, and a positive, leak-inhibiting closure.

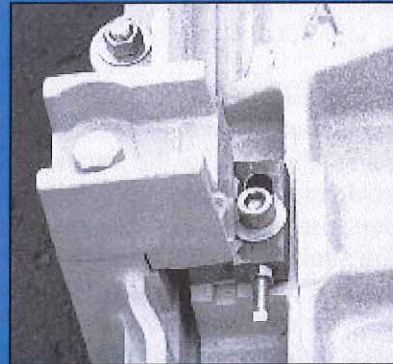
TOP AND BOTTOM WEDGES

When Top and Bottom Wedges are required for unseating heads, fully adjustable units, made of solid corrosion resistant castings, are provided. These wedges are easily adjustable and locked into position with corrosion resistant fasteners. All sliding, mating, and wedging surfaces are fully machined.

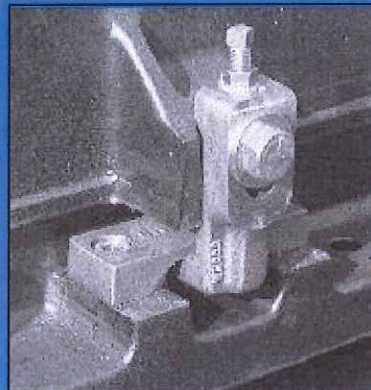
Waterman
Standard
Type "B" Wedge
(Adjustable portion
of wedge on slide)



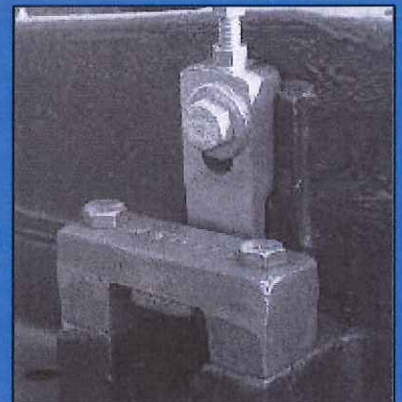
Waterman
Standard
Type "B-1" Wedge



Top Wedge



Bottom Wedge



CAST IRON SLUICE GATE WITH

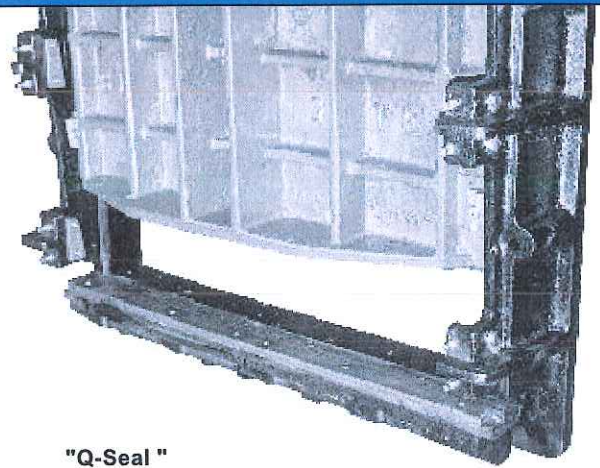
"Q-SEAL" FLUSHBOTTOM SEAL

A "Q-Seal" flushbottom seal gate is used wherever a continuous smooth opening (without obstructions to impede solids) is desirable. Typical installations include wastewater settling tanks, aeration tanks, and sedimentation and flocculation basins.

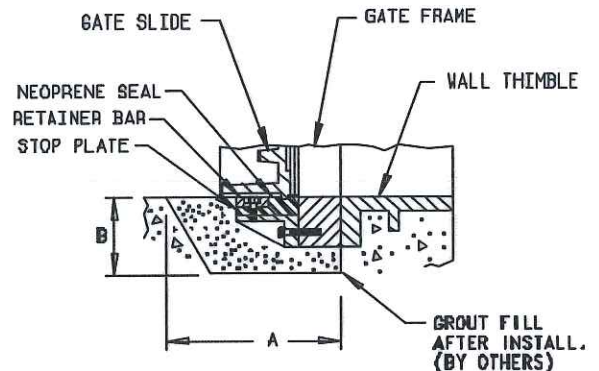
CONSTRUCTION FEATURES

Flushbottom closures feature a neoprene seal securely contained at the invert of the frame. The design of this seal provides a flat plane across the bottom of the gate without projections into the opening to obstruct flow. The seal is mounted on a cast iron bracket and held in place with a corrosion resistant retainer bar and fasteners. The seal is firmly supported on three sides, exposing only the flat top side, minimizing damage from floating objects, wet-dry conditions or sunlight. The seal is easily replaceable without disassembly of the gate.

When a flushbottom seal is used, a smooth rounded projection on the bottom of the slide replaces the normal metal seat and seat facing. The slide closes against the seal, compressing the neoprene between the slide and frame, making a watertight seal across the bottom of the opening. Bottom wedges are not used as they are not necessary for Waterman gates with a flushbottom closure.

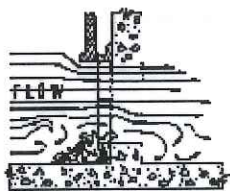


"Q-Seal"
Flushbottom Seal

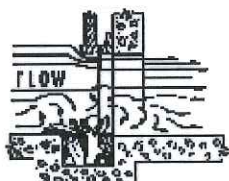


RECOMMENDED INSTALLATION CLEARANCES
FOR FLUSHBOTTOM GATES

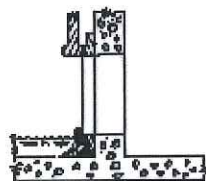
Gate Diameter or Opening Height	Standard Flangeback Gate		Extended Flangeback Gate	
	A	B	A	B
6" thru 24"	12	7	16	15
30" thru 42"	15	7	20	15
48" thru 72"	15	9	23	17
78" thru 120"	18	10	26	18



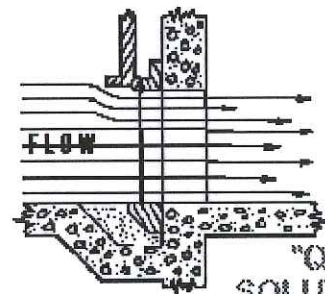
PROBLEM



PROBLEM



PROBLEM



"Q"
SOLUTION

TYPICAL SPECIFICATIONS

SERIES 7000, 5000, 4000 HEAVY DUTY SLUICE GATES

The following specifications for Waterman Heavy Duty Sluice Gates are presented as an aid to the engineer and can be augmented with additional information to meet specific needs.

Scope

This section covers all heavy duty sluice gates required on the project. Each gate shall be furnished and installed complete with wall thimble or anchor bolts, operating stem, gate lift operator and other appurtenances as specified or needed to make a complete and operable installation.

General

Gates, stems, lifts and other appurtenances shall be the size, type, material and construction as shown on the drawings and specified herein. Gates shall meet the requirements of AWWA Specifications C-501 (latest revision) or as modified per these specifications. (They shall be Waterman Heavy Duty Sluice Gates or approved equal.) All component parts shall be of the type of material shown, and interchangeable where size and material are the same without grinding, chipping or special fitting in the field. The gates shall be the product of one manufacturer having five or more years of experience in the manufacture of similar gates for similar use. All mating and sliding parts shall be fully machined. All sluice gate parts, including lift, shall be designed for the heads shown with a minimum safety factor of five.

All materials used in the construction of the gates and appurtenances shall be the best suited for the application and shall be as follows:

Frame and Guide Rails

The frame and guide rails shall be cast one-piece construction or may have guides dowelled and bolted to the frame. Frames shall be of the standard flangeback or extended flange type with round or rectangular opening as indicated on the plans and in the sluice gate schedule. A machined dovetail groove for the mounting of the bronze seat facings shall be provided on the front face of the frame around the full periphery of the opening. The frame shall be provided with cast-on pads which shall be machined, drilled, and tapped for the mounting of the wedge device. The back of the frame flange shall be machined to a plane and drilled to match the wall thimble, pipe flange, or anchor bolt pattern. Guide rails shall be of such length as to retain at least one-half of the vertical height of the slide when it is in the fully opened position. A groove running the full length of the guide rail shall be accurately machined to receive the slide tongue, with a nominal clearance of 1/16-inch.

Cover or Slide

The cover shall be of one piece cast construction with vertical and horizontal ribs, a reinforced pocket to receive the thrust nut, pads to receive the wedges, and a reinforced periphery around the back side of the cover for machining of the dovetail grooves in which the seating faces shall be mounted. All wedge pads shall be machined, drilled and tapped to receive the wedge devices. The cover shall have fully machined tongues running the full length of each side to properly engage the guide rail grooves. A thrust nut shall be provided to attach the slide to the stem. The nut shall be threaded and, in the case of rising stems, provided with keys on two set screws locked into indents in the stem to prevent rotation of the stem. For non-rising stems, the stem shall turn freely in the thrust nut, to open and close the slides as the stem is rotated.

Seating Faces

All seating faces for both covers and frames shall be malleable extruded corrosion resistant material (see materials section) of a shape that will fill and permanently lock in the full width dovetail grooves of the slide and the frame. No other means of attachment will be allowed. They shall be machined to a 63 micro-inch finish, or better.

Wedges

All wedges and wedge blocks shall be solid corrosion resistant material and shall be of sufficient number to provide a practical degree of watertightness. All wedge bearing surfaces and contact faces shall be machined to give maximum contact and wedging action. Wedges shall be fully adjustable, but once set shall not rotate or move from the desired position. All fasteners and adjustment screws shall be corrosion resistant.

Self-Contained Gates with Rising & Non-Rising Stems

When a self-contained gate is specified, a heavy yoke shall be mounted on the machined pads provided on the upper ends of the guide rails. The yoke shall have a machined bearing surface for the lift nut or pedestal mounting plate. On non-rising stems gates the nut pocket shall be cast on top of the slide so that the stem does not project into the waterway when the gate is fully opened. The thrust generated by gate operation shall be transferred to the yoke by the stem thrust collar or lift. When the operating floor is above the self-contained gate, a stem extension of cold-rolled or stainless steel shall be coupled to the operating stem with a bronze coupling or cast iron stem extension bracket. Operation shall be by a T-handle wrench or floor stand, shown on the plans and gate schedule. In a T-handle arrangement the stem extension shall be supported by at least one stem guide or a floor box with integral guide embedded in the operating floor.

Flushbottom Sluice Gates

When a flushbottom closure is specified, a resilient seal shall be attached to the frame so that it is flush with the invert. It shall be supported by a cast iron bracket which shall be bolted to machined pads provided on the frame. The seal shall be held in place by a bronze or stainless steel bar which shall be bolted through the seal to the bracket with stainless steel fasteners. The cover (slide) shall be shortened and provided with a smooth rounded surface along the bottom to depress

the seal. When unseating heads are to be acting on a flushbottom gate, top wedges shall be added, but bottom wedges will not be required. Sealing pressure shall be varied by adjusting side and top wedges.

Wall Thimbles and Anchor Bolts

Wall thimbles shall be provided with all gates except those to be mounted on pipe flanges or those gates to be attached to concrete headwalls with anchor bolts, as shown on the plans. Each thimble shall be of one-piece cast iron construction and of the section and depth as specified in the plans and gate schedule. There shall be integrally cast water stop around the periphery of the thimble. The front flange of the thimble shall be machined, drilled and tapped to receive the sluice gate attaching studs. Bolt pattern shall match gate bolt pattern. After machining, the front flange shall be marked with vertical centerline and the word "top" for correct alignment. Large square and rectangular opening thimbles shall be provided with grout holes in the invert to permit entrapped air to escape. The holes shall be 1/2"x" in diameter, no more than two feet apart and shall be upstream and downstream of the water stop.

A mastic type gasket shall be provided between the sluice gate and the wall thimble. Anchor bolts shall be corrosion resistant.

Gates mounted directly upon the headwall shall be sealed between the gate back and wall with a non-shrink grout. See manufacturers detailed installation instruction.

Stems and Stem Couplings

Operating stems shall be of a size to safely withstand, without buckling or permanent distortion, stresses induced by normal operating forces. Stems shall be fabricated from round bar stock of cold-finished steel, stainless steel or bronze, as shown on the plans or gate schedule and shall be provided with 290 modified or full acme threads. Stems composed of two or more sections shall be joined by bronze couplings threaded and keyed to stems, or couplings of the same material as the stems, pinned, bolted or welded and pinned to the stems. In section, couplings shall be stronger than the stems. Rising stems with manual lifts shall be provided with adjustable limit nuts or stop collars above and below the floor stand lift nut to prevent over travel of the gate in either direction.

Stem Guides

Stem guides shall be cast, with bronze bushings, and mounted on cast brackets. Guides shall be adjustable in two directions and shall be so constructed that when properly spaced they will hold the stem in alignment and still allow enough play to permit easy operation. Stem guide spacing shall be as recommended by the manufacturer, but in no case shall it exceed an l/r ratio of 200. Brackets shall be attached to the wall by anchor bolts and sufficient strength to prevent twisting or sagging under load.

Manually Operated Lifts

Sluice gates shall be operated manually by handwheel or crank operated pedestal floor stands or bench stands as required. Each lift shall be provided with a threaded cast bronze lift nut to engage the threaded portion of the stem. The lift nut shall have a machined flange, fitted above and below with thrust ball or roller bearings. Handwheel lifts shall be without gear reduction while crank operated lifts shall have either a single or double reduction. Lifts having a reduction greater than 4:1 shall be two-speed. A maximum effort of 40 lbs. pull (25 lb. pull) on handwheel or crank, shall operate the gates under the specified operating head. The gears, when required, shall be steel with machine-cut teeth. Pinion gears shall be supported by bronze bushings or roller bearings. The lift mechanism shall be totally enclosed within a cast iron housing adequately provided with lubrication fittings. The pedestal shall be structural steel or cast iron. The crank shall be of cast iron with a revolving brass handle and shall be removable. The crank shall be a maximum of 15" long. All lifts for rising stems shall be provided with a counter type position indicator and a galvanized steel stem cover or a transparent plastic stem cover with mylar strip position indicator. Non-rising stem gates shall be provided with a counter type position indicator unless extension stems, valve boxes, or T-handle wrenches make an indicator impractical. Handwheels and crank input shafts shall be approximately 36" from the operating floor unless otherwise shown. The word "open" shall be cast onto the housing or handwheel indicating direction of rotation to open the gate.

Painting

All cast iron parts of the sluice gate (not bearing or sliding contact) and stem guides shall be painted in accordance with the section on painting found elsewhere in these specifications. That portion of the wall thimbles which will be in contact with concrete shall not be painted.

Shop Testing

The completely assembled gate and hoist shall be separately shop-operated to insure proper assembly and operation. The gate shall be adjusted so that a .004" thick gauge will not be admitted at any point between frame and cover seating surfaces. All gates and equipment shall be inspected and approved by a qualified shop inspector prior to shipment.

Storage and Installation

Sluice gates and equipment shall be stored and installed in accordance with the installation manual furnished by the gate manufacturer. After installation the completely assembled gate, stem, guides and lift shall be operated through one full cycle to demonstrate satisfactory operation. Such adjustments as necessary will be made until operation is approved by the engineer. When required by the engineer, the gate shall be subjected to leakage tests and pass the standard requirements for maximum leakage as specified in AWWA standards AWWA-C-501.

TYPICAL SPECIFICATIONS

MODEL S-5900 HEAVY DUTY SLUICE GATE WITH RESILIENT SEATS

STORAGE AND INSTALLATION

The following specifications for Waterman Heavy Duty Sluice Gates are presented as an aid to the engineer and can be augmented with additional information to meet specific needs.

SCOPE

This section covers all heavy duty sluice gates required on the project. Each gate shall be furnished and installed complete with wall thimble or anchor bolts, operating stem, gate lift operator and other appurtenances as specified or needed to make a complete and operable installation.

PERFORMANCE

The resilient sluice gates must meet the performance requirements of **AWWA C-501** (latest revision) except that the resilient seated sluice gate must allow leakage of no more than .001 gallons per minute per perimeter foot. The resilient seated sluice gate must be able to withstand 25 feet seating, and 25 feet unseating head.

GENERAL

Gates, stems, lifts and other appurtenances shall be the size, type, material and construction as shown on the drawings and specified herein. Gates shall meet the requirements of **AWWA Specifications C-501** (latest revision), with the exception of the seats, as modified per these specifications. (They shall be Waterman Heavy Duty Sluice Gates or approved equal). All component parts shall be of the type of material shown, and interchangeable where size and material are the same without grinding, chipping or special fitting in the field. All mating and sliding metal parts shall be fully machined. All sluice gate parts, including lift, shall be designed for the heads shown with a minimum safety factor of five. All materials used in the construction of the gates and appurtenances shall be the best suited for the application.

FRAME AND GUIDE RAILS

The frame and guide rails shall be cast one-piece construction or may have guides dowelled and bolted to the frame. Frames shall be standard or extended flange type with round or rectangular opening as indicated on the plans and in the sluice gate schedule. Frames shall be of flushbottom design, with a resilient seal attached to the frame so that it is flush with the invert. The frame shall be provided with cast-on pads which shall be machined, drilled, and tapped for the mounting of the wedge devices. The back of the frame flange shall be machined to a plane and drilled to match the wall thimble, pipe flange, or anchor bolt pattern. Guide rails shall be of such length as to retain at least one-half of the vertical height of the slide when it is in the fully opened position. A groove running the full length of the guide rail shall be accurately machined to receive the slide tongue, with a nominal clearance of 1/16 inch.

COVER OR SLIDE

The cover shall be of one piece cast construction with vertical and horizontal ribs, a reinforced pocket to receive the thrust nut, and pads to receive the wedges. All wedge pads shall be machined, drilled and tapped to receive the wedge devices. The cover shall have fully machined tongues running the full length of each side to properly engage the guide rail grooves. A thrust nut shall be provided to attach the slide to the stem. The nut shall be threaded and, in the case of rising stems, provided with keys or two set screws locked into indents in the stem to prevent rotation of the stem. For non-rising stems, the stem shall turn freely in the thrust nut to open and close the slides as the stem is rotated.

SEATING FACES

Seats shall be of a resilient material, which is both abrasion and corrosion resistant. The seat material on both the frame and the cover (slide) shall be permanently attached.

WEDGES

All wedges and wedge blocks shall be solid corrosion resistant material and shall be of sufficient number to provide a practical degree of watertightness. All wedge bearing surfaces and contact faces shall be machined to maximize contact and wedging action. Wedges shall be fully adjustable, but once set shall not rotate or move from the desired position. All fasteners and adjustment screws shall be corrosion resistant.

TESTING, SHOP

The gate shall be adjusted so that the seats are slightly compressed and there is no clearance at any point between frame and cover seating surfaces.

TESTING, FIELD

Same as AWWA C-501-80, Sec. 6.3 except leakage requirements as specified above.

OTHER SPECIFICATIONS

See pages 10 and 11 of Heavy Duty Sluice Gate Specifications for such other items as:

Wall Thimbles and Anchor Bolts	Stem Guides
Stems and Stem Couplings	Painting
Manually Operated Lifts	Storage and Installation
Self-Contained Gates with Rising and Non-Rising Stems	

HEAVY DUTY

MODEL S-5900

RESILIENT SEATED

SLUICE GATE

- LEAKAGE RATE 100 TIMES BETTER THAN AWWA C-501 STANDARD
- 25 FT. SEATING AND UNSEATING HEADS
- STANDARD WITH FLUSHBOTTOM SEAL

FEATURES:

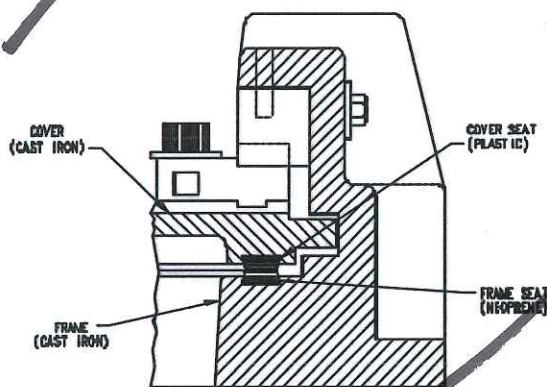
Resilient seated sluice gates are generally used where seating or unseating heads do not exceed 25 feet and a very low leakage rate is required.

PERFORMANCE:

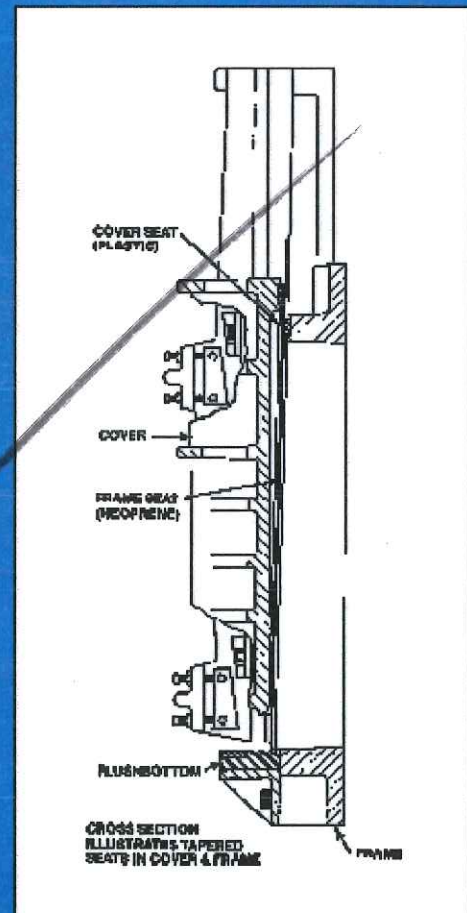
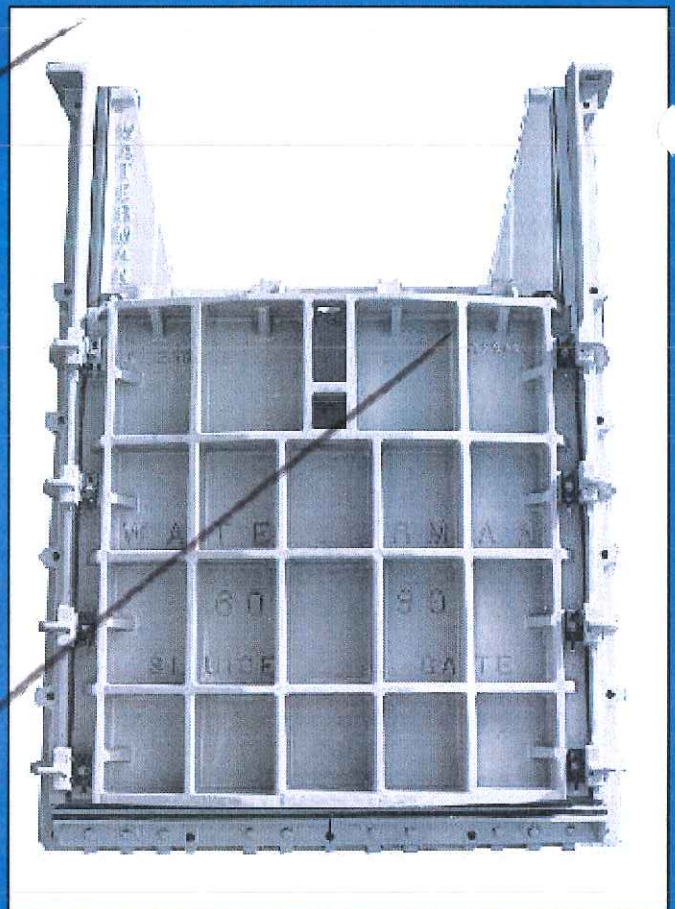
The Waterman resilient seated sluice gate has an allowable leakage rate of only .001 gallons per minute per foot of seating perimeter. **This allowable rate is 100 times better than the AWWA C-501 Standard of .1 GPM.** Our resilient seated sluice gate has been designed and tested to withstand both seating and unseating heads of 25 feet of pressure.

APPLICATION:

With the above exceptions, the Waterman Heavy Duty Sluice Gate with resilient seats is identical to the S-5000 Series Heavy Duty Sluice Gate in virtually every respect. One notable advantage is that the tapered seat is machined at an angle to the guide slot to provide additional wedging action and to minimize wear on the seats by retracting the cover seals from the frame seals upon initial lifting of the cover slide.



RESILIENT SEAT DETAIL



TYPICAL SPECIFICATIONS

MODEL S-5900 HEAVY DUTY SLUICE GATE WITH RESILIENT SEATS

STORAGE AND INSTALLATION

The following specifications for Waterman Heavy Duty Sluice Gates are presented as an aid to the engineer and can be augmented with additional information to meet specific needs.

SCOPE

This section covers all heavy duty sluice gates required on the project. Each gate shall be furnished and installed complete with wall thimble or anchor bolts, operating stem, gate lift operator and other appurtenances as specified or needed to make a complete and operable installation.

PERFORMANCE

The resilient sluice gates must meet the performance requirements of **AWWA C-501** (latest revision) except that the resilient seated sluice gate must allow leakage of no more than .001 gallons per minute per perimeter foot. The resilient seated sluice gate must be able to withstand 25 feet seating, and 25 feet unseating head.

GENERAL

Gates, stems, lifts and other appurtenances shall be the size, type, material and construction as shown on the drawings and specified herein. Gates shall meet the requirements of **AWWA Specifications C-501** (latest revision), with the exception of the seats, as modified per these specifications. (They shall be Waterman Heavy Duty Sluice Gates or approved equal). All component parts shall be of the type of material shown, and interchangeable where size and material are the same without grinding, chipping or special fitting in the field. All mating and sliding metal parts shall be fully machined. All sluice gate parts, including lift, shall be designed for the heads shown with a minimum safety factor of five. All materials used in the construction of the gates and appurtenances shall be the best suited for the application.

FRAME AND GUIDE RAILS

The frame and guide rails shall be cast one-piece construction or may have guides dowelled and bolted to the frame. Frames shall be standard or extended flange type with round or rectangular opening as indicated on the plans and in the sluice gate schedule. Frames shall be of flushbottom design, with a resilient seal attached to the frame so that it is flush with the invert. The frame shall be provided with cast-on pads which shall be machined, drilled, and tapped for the mounting of the wedge devices. The back of the frame flange shall be machined to a plane and drilled to match the wall thimble, pipe flange, or anchor bolt pattern. Guide rails shall be of such length as to retain at least one-half of the vertical height of the slide when it is in the fully opened position. A groove running the full length of the guide rail shall be accurately machined to receive the slide tongue, with a nominal clearance of 1/16 inch.

COVER OR SLIDE

The cover shall be of one piece cast construction with vertical and horizontal ribs, a reinforced pocket to receive the thrust nut, and pads to receive the wedges. All wedge pads shall be machined, drilled and tapped to receive the wedge devices. The cover shall have fully machined tongues running the full length of each side to properly engage the guide rail grooves. A thrust nut shall be provided to attach the slide to the stem. The nut shall be threaded and, in the case of rising stems, provided with keys or two set screws locked into indents in the stem to prevent rotation of the stem. For non-rising stems, the stem shall turn freely in the thrust nut to open and close the slides as the stem is rotated.

SEATING FACES

Seats shall be of a resilient material, which is both abrasion and corrosion resistant. The seat material on both the frame and the cover (slide) shall be permanently attached.

WEDGES

All wedges and wedge blocks shall be solid corrosion resistant material and shall be of sufficient number to provide a practical degree of watertightness. All wedge bearing surfaces and contact faces shall be machined to maximize contact and wedging action. Wedges shall be fully adjustable, but once set shall not rotate or move from the desired position. All fasteners and adjustment screws shall be corrosion resistant.

TESTING, SHOP

The gate shall be adjusted so that the seats are slightly compressed and there is no clearance at any point between frame and cover seating surfaces.

TESTING, FIELD

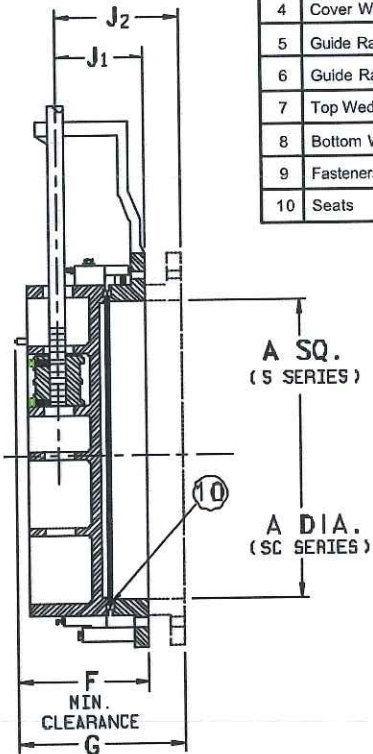
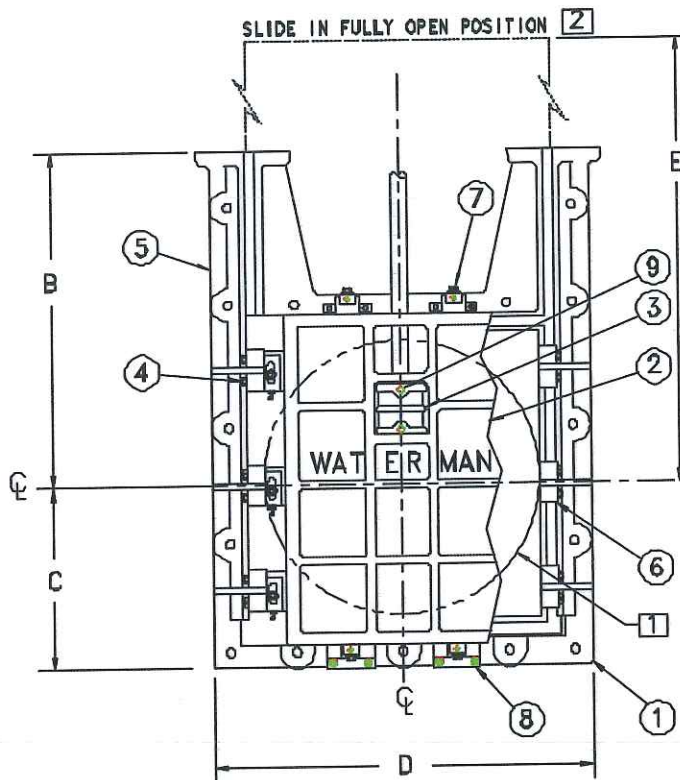
Same as AWWA C-501-80, Sec. 6.3 except leakage requirements as specified above.

OTHER SPECIFICATIONS

See pages 10 and 11 of Heavy Duty Sluice Gate Specifications for such other items as:

Wall Thimbles and Anchor Bolts	Stem Guides
Stems and Stem Couplings	Painting
Manually Operated Lifts	Storage and Installation
Self-Contained Gates with Rising and Non-Rising Stems	

**S-5000 & SC-5000,
S-5900 & SC-5900 ***
SQUARE OR ROUND OPENING
SLUICE GATES**



PARTS	
No.	Name
1	Frame
2	Cover
3	Thrust Nut
4	Cover Wedge Assembly
5	Guide Rails
6	Guide Rail Wedge Assembly
7	Top Wedge Assembly
8	Bottom Wedge Assembly
9	Fasteners
10	Seats

NOTES:

- 1. SC Series shown. S Series gate has square opening.
- 2. Top of NRS cover or top of wedges.

GATE SIZE- ** A	B	C	D	E	F	J1*	G	J2*
6	9 $\frac{3}{4}$	6 $\frac{1}{2}$	14 $\frac{1}{2}$	15	9	4 $\frac{1}{2}$	13	7 $\frac{1}{2}$
8	10 $\frac{1}{8}$	8	17	19	9	4 $\frac{1}{2}$	13	7 $\frac{1}{2}$
10	12	9 $\frac{1}{2}$	19	22	9	5	13	8 $\frac{1}{2}$
12	14 $\frac{1}{4}$	10 $\frac{3}{8}$	20 $\frac{3}{4}$	25	9 $\frac{1}{2}$	5	13 $\frac{1}{2}$	8 $\frac{1}{2}$
14	16	11 $\frac{1}{2}$	23	28	9 $\frac{1}{2}$	5	13 $\frac{1}{2}$	8 $\frac{1}{2}$
15	17	11 $\frac{1}{2}$	23	29 $\frac{1}{2}$	9 $\frac{1}{2}$	5	13 $\frac{1}{2}$	8 $\frac{1}{2}$
16	18	12 $\frac{1}{2}$	25	31	9 $\frac{1}{2}$	5	13 $\frac{1}{2}$	8 $\frac{1}{2}$
18	20 $\frac{3}{4}$	13 $\frac{1}{2}$	27	34	11 $\frac{1}{2}$	6 $\frac{1}{4}$	15 $\frac{1}{2}$	10 $\frac{5}{8}$
20	23 $\frac{3}{4}$	15	30	37	11 $\frac{1}{2}$	6 $\frac{3}{8}$	15 $\frac{1}{2}$	10 $\frac{1}{2}$
21	24	15	30	37 $\frac{1}{2}$	11 $\frac{1}{2}$	6 $\frac{3}{8}$	15 $\frac{1}{2}$	9 $\frac{7}{8}$
24	28 $\frac{1}{2}$	16 $\frac{3}{4}$	33	43	11 $\frac{1}{2}$	7 $\frac{1}{2}$	15 $\frac{1}{2}$	11 $\frac{1}{2}$
30	37 $\frac{1}{2}$	19 $\frac{3}{4}$	39	52	12 $\frac{1}{2}$	7	17	11 $\frac{1}{2}$
36	41 $\frac{1}{2}$	22 $\frac{1}{2}$	45	61	12 $\frac{1}{2}$	7	17	11 $\frac{1}{2}$
42	47 $\frac{1}{2}$	26 $\frac{1}{2}$	52 $\frac{1}{2}$	70	12 $\frac{1}{2}$	8	17	12
48	51 $\frac{1}{4}$	29	57	79	14	8	19	12

* Add for grout pad thickness if applicable.
** Square or Round

GATE SIZE** A	B	C	D	E	F	J1*	G	J2*
54	59 $\frac{1}{4}$	33	66	88	15 $\frac{1}{2}$	8 $\frac{1}{2}$	20	12 $\frac{1}{2}$
60	64	36	72	97	15 $\frac{1}{2}$	8 $\frac{3}{4}$	20	12 $\frac{1}{2}$
66	68	39	78	107	15 $\frac{1}{2}$	9	20	12 $\frac{1}{2}$
72	74	42	84	116	15 $\frac{1}{2}$	9	20	13 $\frac{1}{4}$
78	84	45	90	125	15 $\frac{1}{2}$	10	20	13 $\frac{3}{4}$
84	87	47 $\frac{1}{2}$	95 $\frac{3}{4}$	133	18 $\frac{1}{2}$	9 $\frac{1}{2}$	23	13 $\frac{3}{4}$
90	94	53	106	142	18 $\frac{1}{2}$	11	23	15 $\frac{1}{4}$
96	100	56	112	151	18 $\frac{1}{2}$	11	23	15 $\frac{1}{4}$
108	110	62	124	170	20	11	25	15 $\frac{1}{2}$
120	124	68	136	188	20	11	25	15 $\frac{1}{2}$
132	134	74	148	206	20	12 $\frac{1}{2}$	25	16 $\frac{3}{4}$

* Add for grout pad thickness if applicable.
** Square or Round
*** Size limitations may apply to models S-5900 and SC-5900

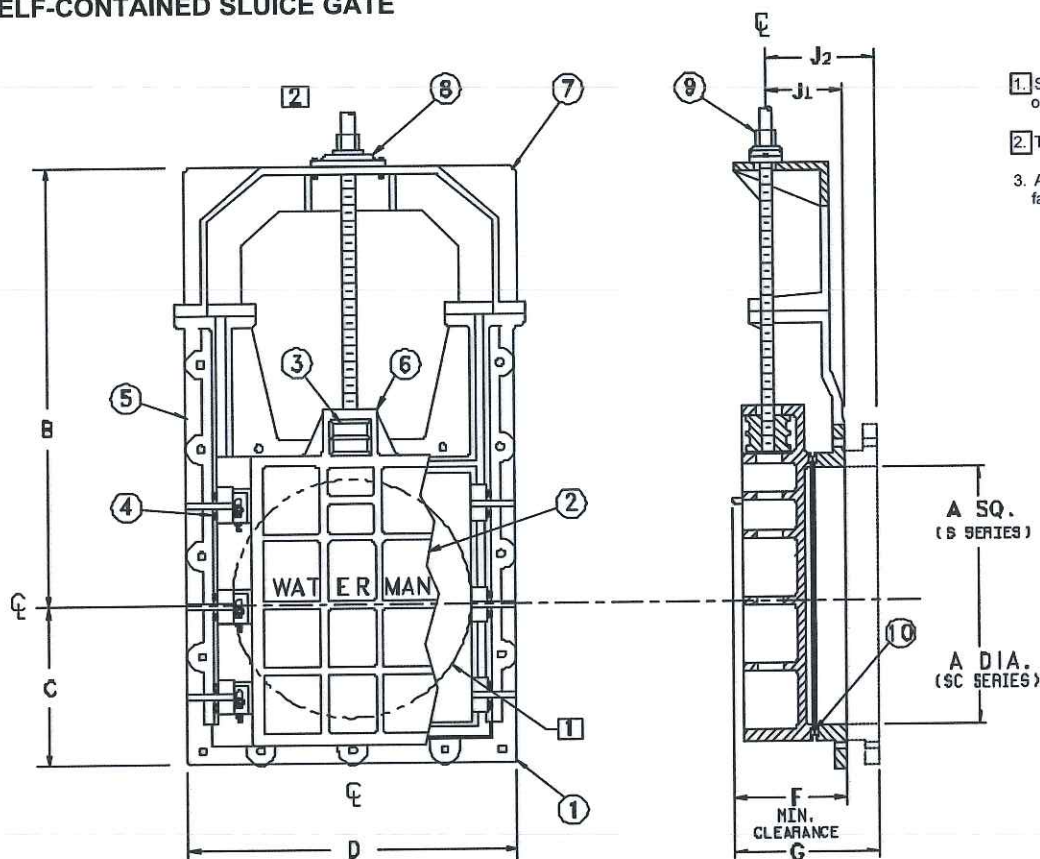
NOTE: FOR PRELIMINARY DESIGN PURPOSES ONLY
DO NOT USE FOR INSTALLATION
UNLESS PART OF CERTIFIED & APPROVED SUBMITTAL

S-5000 & S-5900 RECTANGULAR OPENING (See drawing page 15)

GATE SIZE	B	C	D	E	F	J1	G	J2
12 X 18	20 $\frac{3}{4}$	13 $\frac{1}{2}$	20 $\frac{3}{4}$	34	11 $\frac{1}{2}$	5	15 $\frac{1}{2}$	8 $\frac{3}{4}$
12 X 24	28 $\frac{1}{2}$	17 $\frac{1}{4}$	21	43	11 $\frac{1}{2}$	7	15 $\frac{1}{2}$	11
12 X 36	38	22 $\frac{1}{2}$	20 $\frac{3}{4}$	61	12 $\frac{1}{2}$	7	17	11
15 X 18	20 $\frac{3}{4}$	13 $\frac{1}{2}$	24	34	11 $\frac{1}{2}$	6 $\frac{1}{4}$	15 $\frac{1}{2}$	9 $\frac{7}{8}$
18 X 6	9 $\frac{3}{4}$	7 $\frac{1}{2}$	27	15	11 $\frac{1}{2}$	6 $\frac{1}{4}$	15 $\frac{1}{2}$	9
18 X 12	16 $\frac{3}{4}$	9 $\frac{3}{4}$	26	25	9 $\frac{3}{4}$	4 $\frac{3}{4}$	15 $\frac{1}{2}$	8 $\frac{1}{2}$
18 X 24	26 $\frac{1}{2}$	16 $\frac{3}{4}$	27 $\frac{1}{4}$	43	11 $\frac{1}{2}$	7	15 $\frac{1}{2}$	11
18 X 30	37 $\frac{1}{2}$	19 $\frac{3}{4}$	27	52	12 $\frac{1}{2}$	7	17	11
18 X 36	38	22 $\frac{1}{2}$	27	61	12 $\frac{1}{2}$	7	17	11
18 X 48	51 $\frac{1}{4}$	29	27	79	14	7	19	11 $\frac{1}{2}$
18 X 72	74 $\frac{3}{8}$	41	27	116	14	7	19	11 $\frac{1}{2}$
24 X 12	14 $\frac{1}{4}$	10 $\frac{3}{4}$	33	25	11 $\frac{1}{2}$	6 $\frac{1}{2}$	15 $\frac{1}{2}$	9 $\frac{1}{2}$
24 X 18	19	13 $\frac{1}{2}$	33	34	11 $\frac{1}{2}$	7	15 $\frac{1}{2}$	10 $\frac{3}{4}$
24 X 30	37 $\frac{1}{2}$	19 $\frac{3}{4}$	33	52	12 $\frac{1}{2}$	7	17	11
24 X 36	38	22 $\frac{1}{2}$	33	61	12 $\frac{1}{2}$	7	17	11 $\frac{1}{2}$
24 X 42	47 $\frac{1}{4}$	26 $\frac{1}{2}$	33	70	12 $\frac{1}{2}$	7	17	11 $\frac{1}{2}$
24 X 48	50	29	33 $\frac{1}{2}$	79	14	7	19	11
30 X 18	20 $\frac{3}{4}$	13 $\frac{1}{2}$	39	34	12 $\frac{1}{2}$	7	17	11 $\frac{1}{2}$
30 X 24	28 $\frac{1}{2}$	16 $\frac{1}{2}$	39	43	12 $\frac{1}{2}$	7	17	11 $\frac{1}{2}$
30 X 36	41 $\frac{1}{4}$	22 $\frac{1}{2}$	39	61	12 $\frac{1}{2}$	7	17	11
30 X 42	47 $\frac{1}{2}$	26 $\frac{1}{2}$	40 $\frac{1}{2}$	70	12 $\frac{1}{2}$	8	17	12
30 X 48	51 $\frac{1}{4}$	29 $\frac{1}{2}$	41	79	14	8	19	12
30 X 60	64	36	42	97	15 $\frac{1}{2}$	8	20	12 $\frac{1}{2}$
30 X 72	75	42	42	116	15 $\frac{1}{2}$	8	20	12 $\frac{1}{2}$
36 X 12	14 $\frac{1}{4}$	10 $\frac{3}{4}$	45 $\frac{1}{2}$	25	12 $\frac{1}{2}$	7	17	11
36 X 18	20 $\frac{3}{4}$	13 $\frac{3}{4}$	45 $\frac{1}{2}$	34	12 $\frac{1}{2}$	7	17	11
36 X 24	28 $\frac{1}{2}$	16 $\frac{3}{4}$	45	43	12 $\frac{1}{2}$	7	17	11
36 X 30	32	19 $\frac{3}{4}$	45	52	12 $\frac{1}{2}$	7	17	11
36 X 42	47 $\frac{1}{4}$	26	46	70	12 $\frac{1}{2}$	8	17	12
36 X 48	51 $\frac{1}{4}$	29 $\frac{1}{2}$	47	79	14	8	19	12
36 X 60	64	36	48	97	15 $\frac{1}{2}$	8	20	12 $\frac{1}{2}$
36 X 72	74	42	48	116	15 $\frac{1}{2}$	8	20	12 $\frac{1}{2}$
36 X 84	87	48	48	139	18 $\frac{1}{2}$	9 $\frac{1}{2}$	23	13 $\frac{3}{4}$
39 X 84	87	48	51	139	18 $\frac{1}{2}$	9 $\frac{1}{2}$	23	13 $\frac{3}{4}$
42 X 30	37 $\frac{1}{2}$	20 $\frac{1}{4}$	52 $\frac{1}{2}$	52	12 $\frac{1}{2}$	8	17	12
42 X 36	41 $\frac{1}{2}$	23 $\frac{1}{4}$	52 $\frac{1}{2}$	61	12 $\frac{1}{2}$	8	17	12
42 X 48	51 $\frac{1}{4}$	29	52 $\frac{1}{2}$	79	14	8	19	12
42 X 54	66 $\frac{1}{4}$	32 $\frac{1}{4}$	52 $\frac{1}{2}$	91	12 $\frac{1}{2}$	8	17	12
42 X 60	64	36	54	97	15 $\frac{1}{2}$	8	20	12 $\frac{1}{2}$
42 X 72	74 $\frac{1}{4}$	42	54 $\frac{1}{4}$	116	15	8	20	12 $\frac{1}{2}$
48 X 24	28 $\frac{1}{2}$	17	58	43	14	8	19	12
48 X 30	32	20 $\frac{1}{2}$	59	52	14	8	19	12
48 X 36	38	23 $\frac{1}{2}$	59	61	14	8	19	12
48 X 42	47 $\frac{1}{2}$	26 $\frac{1}{2}$	59	70	14	8	19	12
48 X 54	59 $\frac{1}{4}$	33	60	88	14	8	19	12 $\frac{1}{2}$
48 X 60	62 $\frac{1}{2}$	36	60	97	15 $\frac{1}{2}$	8	20	12

GATE SIZE	B	C	D	E	F	J1	G	J2
48 X 72	74	42	60	116	15 $\frac{1}{2}$	9	20	13 $\frac{1}{4}$
48 X 84	87	48	60	133	18 $\frac{1}{2}$	9	23	13
48 X 96	100	56	64	155	18 $\frac{1}{2}$	11	23	15 $\frac{1}{4}$
48 X 120	124	68	64	187	20	11	25	15 $\frac{1}{2}$
54 X 24	28 $\frac{1}{2}$	18	66	43	15 $\frac{1}{2}$	8 $\frac{1}{2}$	20	12 $\frac{1}{2}$
54 X 36	41 $\frac{1}{2}$	24	66	61	15 $\frac{1}{2}$	8	20	12
54 X 48	51 $\frac{1}{4}$	30	66	79	15 $\frac{1}{2}$	8 $\frac{1}{2}$	20	12 $\frac{1}{2}$
54 X 60	64	36	66	97	15 $\frac{1}{2}$	8 $\frac{3}{4}$	20	12 $\frac{1}{2}$
54 X 72	75	42	66	116	15 $\frac{1}{2}$	9	20	13 $\frac{1}{4}$
54 X 84	87	48	66	133	14	8 $\frac{1}{2}$	21 $\frac{1}{4}$	12
60 X 36	38	24	72	61	15 $\frac{1}{2}$	8	20	12
60 X 48	52 $\frac{1}{2}$	30	72	79	15 $\frac{1}{2}$	8 $\frac{1}{2}$	20	12 $\frac{1}{2}$
60 X 72	74	42	72	116	15 $\frac{1}{2}$	9	20	13 $\frac{1}{4}$
60 X 84	87	48	72	133	18 $\frac{1}{2}$	8 $\frac{1}{2}$	23	12
60 X 96	100	56	76	151	18 $\frac{1}{2}$	11	23	15
60 X 120	124	68	76	191	20	13	25	15 $\frac{1}{2}$
72 X 36	41 $\frac{1}{2}$	24	84	61	15 $\frac{1}{2}$	8	20	12
72 X 48	51 $\frac{1}{2}$	30	84	79	15 $\frac{1}{2}$	9	20	13
72 X 54	56	33	84	88	15 $\frac{1}{2}$	9	20	12 $\frac{1}{2}$
72 X 60	63 $\frac{1}{4}$	36	84	97	15 $\frac{1}{2}$	9	20	13 $\frac{1}{4}$
72 X 84	87	47 $\frac{7}{8}$	84	133	18 $\frac{1}{2}$	9 $\frac{3}{4}$	23	13 $\frac{3}{4}$
72 X 96	100	56	88	151	18 $\frac{1}{2}$	11	23	15 $\frac{1}{4}$
72 X 108	110	62	88	170	14	11	19	15 $\frac{1}{2}$
84 X 48	52	30	96	79	18 $\frac{1}{2}$	8	23	12 $\frac{1}{2}$
84 X 60	64	36	96	97	18 $\frac{1}{2}$	8 $\frac{1}{2}$	23	12
84 X 66	68	39	96	107	18 $\frac{1}{2}$	9 $\frac{1}{2}$	23	13 $\frac{3}{4}$
84 X 72	74 $\frac{3}{8}$	42	96	115	18 $\frac{1}{2}$	9 $\frac{1}{2}$	23	13 $\frac{3}{4}$
84 X 108	110	62	100	170	14	11	19	15 $\frac{1}{2}$
96 X 24	28 $\frac{1}{2}$	18	108	43	18 $\frac{1}{2}$	10 $\frac{1}{2}$	23	14 $\frac{1}{2}$
96 X 36	41 $\frac{1}{2}$	24	108	61	18 $\frac{1}{2}$	10 $\frac{1}{2}$	23	14 $\frac{1}{2}$
96 X 42	47 $\frac{1}{2}$	27	108	70	14	10 $\frac{1}{2}$	19	14 $\frac{1}{2}$
96 X 60	64	36	108	97	18 $\frac{1}{2}$	11	23	15 $\frac{1}{4}$
96 X 72	74	44	112	116	18 $\frac{1}{2}$	11	23	15 $\frac{1}{4}$
96 X 120	124	68	112	187	20	11	25	15 $\frac{1}{4}$
102 X 78	82	45	114	124	20	11	25	16
108 X 60	64	38	124	97	20	11	25	15
108 X 72	74	44	124	116	20	11	25	15
108 X 84	87	50	124	133	20	11	25	15 $\frac{1}{2}$
108 X 120	124	68	124	187	20	12	25	16 $\frac{1}{2}$
108 X 144	150	80	124	225	20 $\frac{3}{4}$	12 $\frac{1}{2}$	27 $\frac{1}{4}$	17 $\frac{3}{4}$
120 X 60	64	36	136	97	18 $\frac{1}{2}$	11	23	15 $\frac{1}{4}$
120 X 72	74	44	136	116	20	11	25	15 $\frac{1}{2}$
120 X 84	87	50	136	133	20	11	25	15 $\frac{1}{2}$
120 X 96	100	56	136	151	20	11	25	15 $\frac{1}{2}$
120 X 108	110	62	136	175	20	11	25	15 $\frac{1}{2}$
120 X 132	134	74	136	208	21 $\frac{3}{4}$	12 $\frac{1}{2}$	27 $\frac{1}{4}$	18
144 X 84	87	50	160	133	22	11	27	15

S-5000-Y, SC-5000-Y, S-5900-Y & SC-5900-Y **
SELF-CONTAINED SLUICE GATE



1. SC Series shown. S Series gate has square opening.
2. Type 1 lift shown. Geared lifts also available.
3. All gates are available with special height fabricated steel or stainless steel yokes.

PARTS	
No.	Name
1	Frame
2	Cover
3	Thrust Nut
4	Side Wedge Assy.
5	Guide Rail
6	NRS Bracket
7	Yoke
8	Lift Collar
9	Lift Nut
10	Seats (non-corrosive)

GATE SIZE A	B	C	D	F	J1*	G	J2*
6	16	6½	14½	9½	4½	13½	7½
8	21½	8	17	9½	4½	13½	7½
10	24½	9½	19	9½	5	13½	8½
12	27¾	10¾	20¾	10	5	14	8½
14	30	11½	23	10	5	14	8½
15	31¼	11½	23	10	5	14	8½
16	33½	12½	25	10	5	14	8½
18	37	13½	27	12	6¼	16	10⅝
20	41½	15	30	12	6⅝	16	10½
21	41½	15	30	12	6⅝	16	10
24	46	16¾	33	12	7½	16	11½
30	55	19¾	39	13	7	17½	11½
36	64	22½	45	13	7	17½	11½
42	73½	26½	52½	13	8	17½	12
48	82	29	57	14½	8	19½	12
54	111	33	66	15½	8½	20	12½
60	116	36	72	15½	8¼	20	12½
66	127	39	78	15½	9	20	12½
72	138	42	84	16¾	9¼	20¾	13¼
78	141	45	90	15½	10	20	13¾
84	150	47½	95¾	18½	9½	23	13¾

* Add for grout pad thickness if applicable.

** Size limitations may apply to models S-5900 and SC-5900.

GATE SIZE	B	C	D	F	J1	G	J2
12 x 24	44	17¼	21	11½	7	15½	11
12 x 36	62¾	22½	20¾	12½	7	17	11
15 x 18	36½	13½	24	11½	6¼	15½	9⅞
18 x 6	26	7½	27	11½	6¼	15½	9
18 x 30	55	19¾	27	12½	7	17	11
18 x 36	63⅝	22½	27	12½	7	17	11
24 x 18	37¼	13½	33	11½	7	15½	10¾
24 x 30	55	19¾	33	12½	7	17	11
24 x 36	63½	22½	33	12½	7	17	11½
24 x 48	81	29	33½	14	7	19	11
30 x 18	38¼	13½	39	12½	7	17	11½
30 x 24	46	16½	39	12½	7	17	11½
30 x 36	64¾	22½	39	12½	7	17	11
30 x 42	73½	26½	40½	12½	8	17	12
30 x 60	104	36	42	15½	8	20	12½
42 x 36	67½	23¼	52½	12½	8	17	12
42 x 54	95	32¼	52½	12½	8	17	12
48 x 24	59¼	17	58	14	8	19	12
48 x 30	62¾	20½	59	14	8	19	12
48 x 42	73½	26½	59	14	8	19	12
48 x 60	102¾	36	60	15½	8	20	12



INSTALLATION MANUAL FOR

- Sluice Gates
- Fabricated Gates
- Drainage Gates
- Specialty Gates

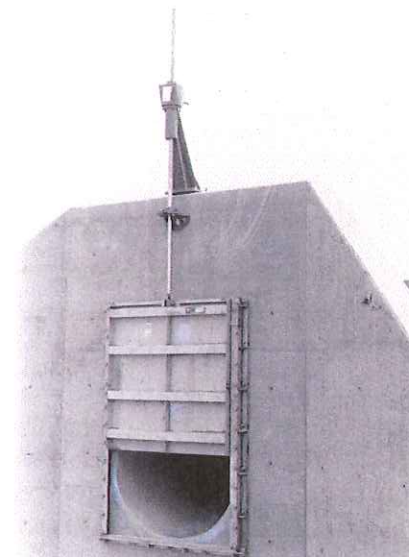
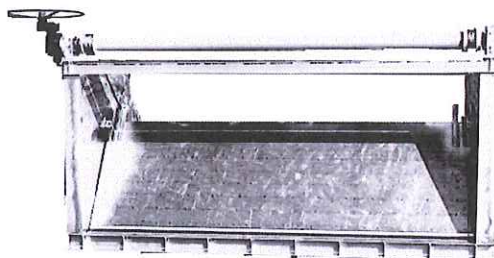


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HEAVY DUTY SLUICE GATE INSTALLATION INSTRUCTIONS

FOREWORD

The purpose of this manual is to provide the contractor with all pertinent information for the proper installation of our Series 4000/5000/7000 and P-32 sluice gates. Although every care is taken in our factory to insure top quality equipment, we cannot be responsible for damage caused by negligence after shipping. Therefore, described herein are Waterman's recommended methods of handling, storage, installation, adjustment and initial operation for standard situations, to be used in conjunction with the approved installation drawings provided by Waterman Industries, Inc. If proper care and accuracy are exercised in the field when installing our gates, they will operate as designed at maximum efficiency.

RECEIVING, HANDLING AND STORAGE

✓ **Check count** on all parts when you receive a shipment, noting any shortages immediately. We cannot be responsible for shortages reported after any lengthy delay. Special care should be taken in accounting for and safely storing all bolts, nuts, and small items which are often misplaced at jobsites. (Waterman double counts these parts to assure accuracy.)

All Waterman gates and appurtenances are precision machinery and should be handled accordingly. While all parts are of a rugged design, it is nevertheless possible to warp machined surfaces, stems, etc., through improper storage and handling. To avoid all problems of this nature we recommend the following:

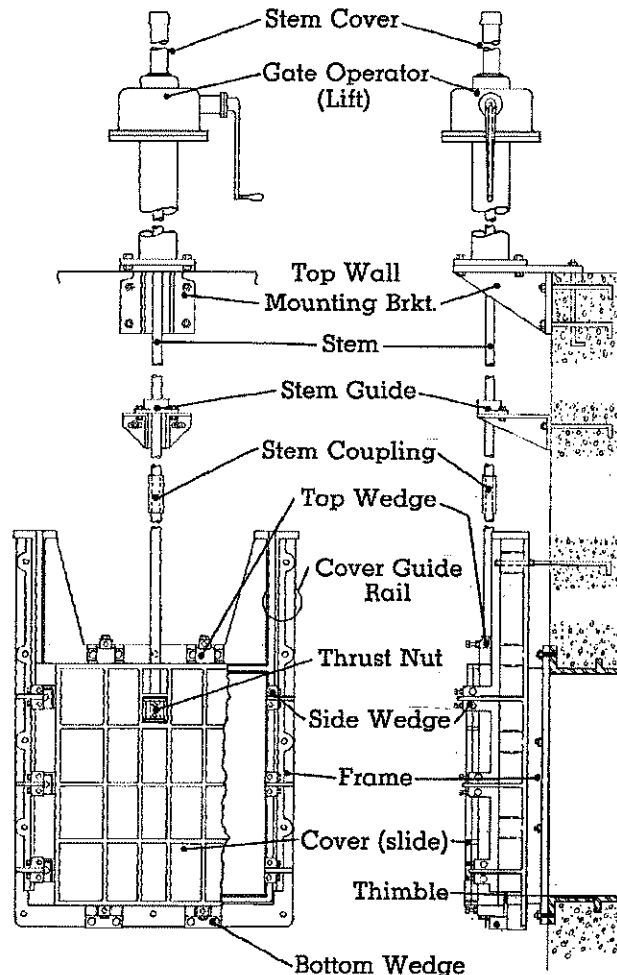
1. Lift gates through stem hole in top of lift nut box on cover only when shipping stops are in place, taking particular care of wedges and seats.
2. Support full length of stems at all times, being sure not to damage threads.
3. Store equipment on an even, clean, dry surface to prevent distortion.
4. Cover all equipment to protect machined surfaces.
5. **Do not** stack equipment without protection.
6. Handle lifts as you would any precision machinery.

CAUTION: This gate has been adjusted at the factory. **DO NOT DISASSEMBLE.** Refer to operation manual before attempting to adjust. **DO NOT** paint bronze, stainless steel or machined surfaces as damage may result.

PROCEDURE FOR INSTALLING A STANDARD FLANGEBACK OR EXTENDED FLANGEBACK GATE ON A CONCRETE HEADWALL

1. Secure all anchor bolts in proper position in the forms, checking carefully to see that size, projection, perpendicular and horizontal alignments conform to requirements shown on our illustration. Extreme care must be exercised in this initial procedure in that bolts which are improperly set will cause gate warpage and therefore excess leakage between the seating surfaces. **Do Not Force Gate Onto Misaligned Bolts.**

Figure 1



2. Each bolt has been provided with two nuts to facilitate proper mounting of the gate. In setting the forms, provide a recess around the perimeter of the gate, as shown in Figure 2. This is recommended only if access from the back of the gate is possible, allowing easy adjustment of the back nut. Otherwise sufficient grout space must be left for adjustment of the back nut as shown in Figure 3. **Note:** In this case, the projection specified on our installation drawing must be increased by the amount of the grout space allowed.

3. After concrete has been poured and the forms have been stripped, place one nut on each anchor bolt and run down against headwall. **Do Not Disassemble Gate For Installation.** Place the completely assembled gate into position carefully guiding it onto the anchor bolts. (Again we must reiterate, **Do Not Force Gate Onto Misaligned Bolts.** See 1, page 2.) Place the second nut on each bolt and bring both front and back nuts into finger-tight contact with gate frame, aligning it as necessary. At this point, check clearance between seating surfaces (from back of gate if possible) with .004" feeler gauge. If gate is seating properly, the gauge will not be admitted at any point. In the event that the gate is not seating properly, check to see if gate has been warped during installation. If so, adjust nuts on anchor bolts to bring frame into flatness. Otherwise a single adjustment of the wedges is all that is necessary. (see section on wedge adjustments.)

4. After gate is found to be seating properly, carefully drypack or grout in the gate between frame and headwall using a non-shrink material. Check for voids after it has set and fill in as necessary.

5. Tighten all nuts on anchor bolts uniformly, taking care not to warp gate to conform to uneven surface. Gate is now ready for initial operation. **Note:** In those locations where extended flangeback gates are used on headwalls without sufficient side or bottom clearance for nut adjustments, anchor bolts can be brought through the gate frame to the front face. Special anchors and frame drilling must be ordered.

Figure 2

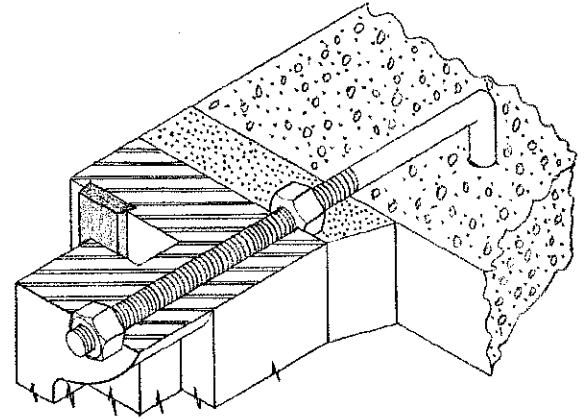
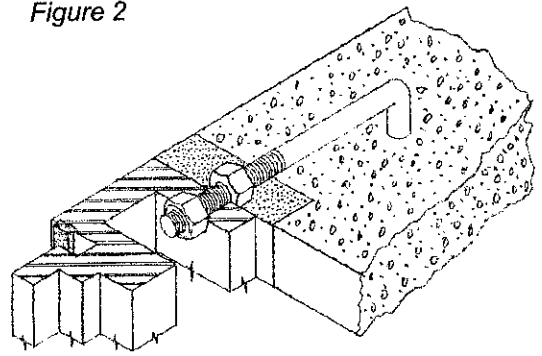


Figure 3

PROCEDURE FOR INSTALLING A STANDARD FLANGEBACK OR EXTENDED FLANGEBACK GATE ON A WALL THIMBLE OR PIPE FLANGE

1. Place the thimble in correct position in the forms and secure in place. The top (marked on the flange face) should be aligned with a plumb. Thimble should be flush or projecting slightly from the head wall face.
2. Use timbers or other bracing on the inside of the opening to support the thimble and prevent warpage during the pour. This is especially important on larger thimbles or when the concrete cover will be especially high.
3. Plug the tapped holes in the thimble with the studs provided or other removable plugs that will prevent concrete from entering the tapped holes.
4. Secure anchor bolts for guide rail extensions (or provide block out) in the proper position as given on our installation drawing, (your submittal drawing provided by the manufacturer). Check projection and perpendicular alignment of these anchors.
5. Pour concrete, using care not to tilt or move thimble from its original position in the forms.
6. Let concrete set, then remove forms and bracing. Thoroughly clean the front machined face of the thimble and place cleaned studs into tapped holes provided.
7. Clean the back of the gate frame or flange thoroughly. Apply a thin coat of mastic (such as butyl rubber compound or black asphaltic compound), on the front face of the thimble.
8. Mount the completely assembled gate on the thimble. Place nuts on studs and tighten uniformly until a metal to metal contact is made, removing excess mastic.
9. Check clearance between seating surfaces with .004" feeler gauge. In the event that the gate is not seating properly, make wedge adjustments. (Another cause of improper seating is warpage of gate frame due to mounting on thimble which has been warped during the pouring of concrete. If steps one through five are strictly adhered to this will be avoided and the mounting of the gate will be a simple procedure.) Gate is now ready for initial operation.

PROCEDURE FOR INSTALLING STEMS AND STEM GUIDES

1. After the gate has been mounted and shipping stops have been removed, lower short-threaded end of stem through holes in upper ribs of cover.
2. Thread stem into thrust nut in nut pocket on cover until flush with bottom of nut.
3. Tighten set screws on nut into indents in stem.
4. Mount stem guides in order from bottom up as stem is installed. Do not tighten stem guide assembly bolts.
5. Install stem couplings as required, being sure to tighten all set screws or drive in pins.
6. Take care not to bend stems or damage threads during installation.

PROCEDURE FOR INSTALLING LIFTS

Manually Operated Lifts

1. After assembling stem as described earlier, lower the lift over the upper threaded portion of stem, carefully engaging threads of lift nut and stem.
2. Bring base of lift over anchor bolts to about 1" from floor and adjust lower nut until proper vertical alignment is achieved. (Not necessary with wall bracket mounting.)
3. Tighten top nuts on anchor bolts and grout in place.
4. Once the lift is properly installed, apply tension to the stem with the lift and align the stem guides. Tighten stem guide assembly bolts.

Hydraulic Cylinder Lifts

1. Lower cylinder onto mounting device and align and secure as described above.
2. Couple the piston rod to the stem.
3. Attach pertinent hardware to cylinder.
4. Put tension on stem with lift and set stem guides.
5. With the piston down against the lower head of the cylinder, and the gate in the fully closed position, rotate the stem in the thrust nut until the nut fits snugly against the bottom of the nut pocket.
6. Tighten all set screws.

Electric Lifts

1. Install in the same manner as the manual lifts.
2. After alignment, manually open gate a few inches before initial electric operation. This is a safety measure to protect the gate in case lift has been improperly connected.

INSTALLATION ON TOP WALL MOUNTING BRACKET

1. Mount top wall mounting bracket on anchor bolts, and secure with nuts. Top surface must be aligned perpendicular * with stem, and stem must pass approximately through center of stem slot.
*If wall face or top is unduly rough or badly out of plumb, wall may need to be grout-faced to provide proper mounting surface for bracket.
2. After assembling stem *, loosen the lift over the upper threaded portion of stem carefully engaging threads of lift nut and stem.
* If a limit nut is to be used to stop upward gate travel, it must be installed on the stem prior to installing the lift.
3. Bring base over top of bracket and mount with four bolts and nuts. Adjust floorstand until proper alignment is achieved. Tighten bolts.
4. Once the lift is properly installed, apply tension to the stem with the lift and align the stem guides. Tighten stem guide assembly bolts.

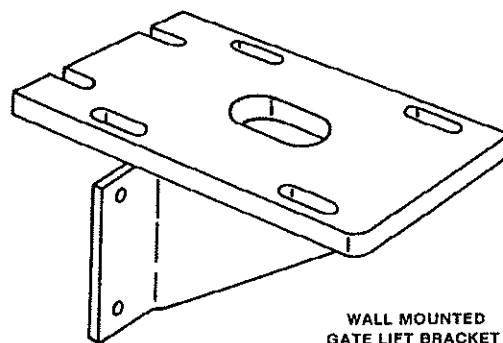


Figure 4

SETTING POSITION INDICATORS

1. When installing a manually operated lift with position indicator, remove the indicator prior to mounting.
2. After the lift has been properly installed, lower the gate until the bottom seating surface of the cover just meets the bottom seating surface of the frame. This is the point of zero opening.
3. Set the indicator to zero and replace it on the lift, making sure that as the gears are engaged the indicator does not move from zero.
4. Note that in the full wedging position, the indicator will read less than zero.
5. See manufacturer's instructions for the setting of electric lifts.

PROCEDURE FOR SETTING CLEAR PLASTIC STEM COVER INDICATORS

1. Indicator strips are attached after the lift and stem cover have been installed and the gate has been adjusted for proper seating.
2. Be certain that the stem cover is clean and dry, inside and out. Use mild detergent or commercial cleaners specifically made for plastic.
3. Observe through the stem cover where the top of the stem is positioned when the gate is fully closed. Make a small mark on the outside of the stem cover at this point. This is your "zero" reference.
4. The mylar strip is graduated in increments with "0" at the bottom. Peel off the paper backing (the mylar strip is self-adhesive) then starting at the "zero" reference attach the mylar strip, taking care to avoid bubbles and wrinkles.
5. Cut off any excess strip that extends past the pipe cap.

CLEANING AND ADJUSTING

1. After installation of the stem, stem guides, and lifting mechanism, move slide (cover) to fully open position. **Be sure shipping stops have been removed.**
2. Clear all dirt, paint, etc. off of seating and wedging surfaces, and clean loose concrete and grout from top of gate.
3. Grease seating and wedging surfaces with water resistant grease.
4. Close gate completely and check for proper wedge adjustment. **Note:** All wedges are factory adjusted before shipment, but may have loosened during shipping, handling and installation. Use a .004" feeler gauge to check for excess clearance between seating faces. (Best results can be obtained by checking seat faces from back side of gate when installation permits.)

PROCEDURE FOR ADJUSTING SIDE WEDGES ON SERIES 4000 UP TO 14"

1. Loosen wedge locking nut on guiderail (A1).
2. Loosen adjusting screw lock nut (A2).
3. Tighten adjusting screw (A3) until proper seating is attained.
4. Tighten wedge locking nut (A1).
5. Tighten adjusting screw lockout (A2).

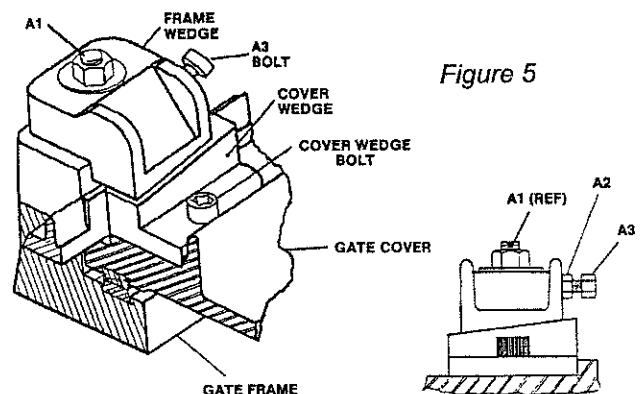


Figure 5

PROCEDURE FOR ADJUSTING SIDE WEDGES ON SERIES 4000 15" AND LARGER

Side wedges (adjustable portion of wedge on slide)

1. Open gate slightly.
2. Loosen locking nut (B1) [1/2" nc hex nut].
3. Loosen adjusting screw lock nut (B2) [3/8" nc hex nut].
4. Move wedge down into desired position by turning adjusting screw (B3) [3/8" nc x 1 1/4" lg hex hd bolt].
5. Tighten locking bolts (B1).
6. Tighten adjusting screw lock nut (B2).
7. Close gate and check with .004" feeler gauge.
8. Repeat procedure as necessary until desired closing is attained.
9. Check to see that gate cover will repeat final closed position. If gate cover will not repeat - readjust.

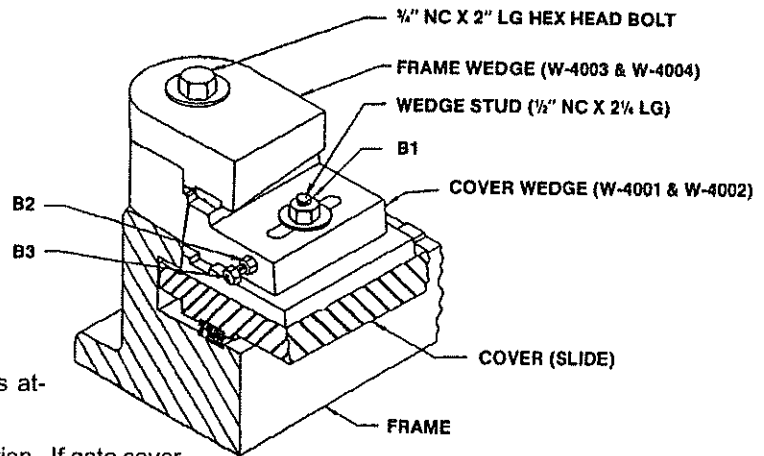


Figure 6

PROCEDURE FOR ADJUSTING TYPE A SIDE WEDGES ON SERIES 5000/7000 SLUICE GATES

Type "A" Standard Side Wedges

(Adjustable portion of wedge on guide rail)

1. Loosen wedge locking bolts on guide rail (A1) [1/2" nc x 2 lg hex hd bolt].
2. Loosen adjusting screw lock nuts (A2) [3/8" nc hex nut].
3. Tighten both adjusting screws until proper seating is attained (A3) [3/8" nc x 2 1/2" lg sq hd set screw].
4. Tighten locking bolts (A1).
5. Tighten adjusting screw lock nuts (A2).
6. Upon final adjustment of wedges check to see that gate cover will repeat its final closing travel. If wedges are set too tight gate position on full closure cannot be repeated. If gate will not repeat - readjust wedges.

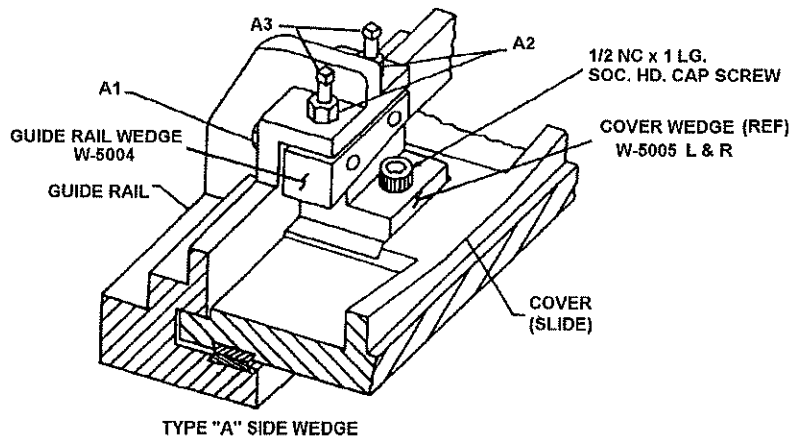


Figure 7

PROCEDURE FOR ADJUSTING TYPE B SIDE WEDGES ON SERIES 5000/7000 SLUICE GATES

Type "B" Side Wedges

(Adjustable portion of wedge on slide)

1. Open gate slightly.
2. Loosen locking bolts (B1) [5/8" nc x 1 1/2" lg. sq. hd. set screw].
3. Loosen adjusting screw lock nut (B2) [3/8" nc hex].
4. Move wedge down into desired position by turning adjusting screw (B3) [3/8" nc x 2 1/2" lg sq. hd. set screw].
5. Tighten locking bolts (B1).
6. Tighten adjusting screw lock nut (B2).
7. Close gate and check with .004" feeler gauge.
8. Repeat procedure as necessary until desired closing is attained.
9. Check to see that gate cover will repeat final closed position. If gate cover will not repeat - readjust.

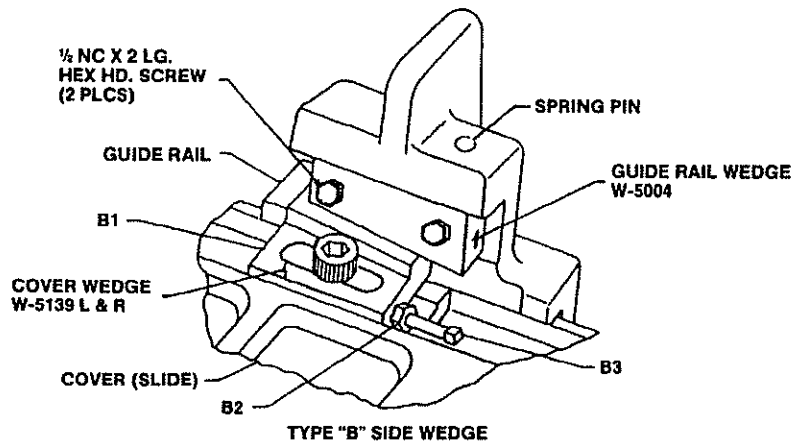


Figure 8

PROCEDURE FOR ADJUSTING TYPE B-1 SIDE WEDGES ON SERIES 5000 SLUICE GATES

1. Open gate slightly.
2. Loosen wedge lock nut (C1) $\frac{5}{8}$ " hex nut.
3. Loosen adjusting screw lock nut.
4. Move wedge up or down as desired (up to decrease wedge action, down to increase wedge action) turning adjusting screw against cover wedge stud.
5. Tighten wedge locknut (C1).
6. Tighten adjusting screw locknut.
7. Close gate and check seat clearance with .004" feeler gauge.
8. Repeat procedure as necessary until desired closing is attained.

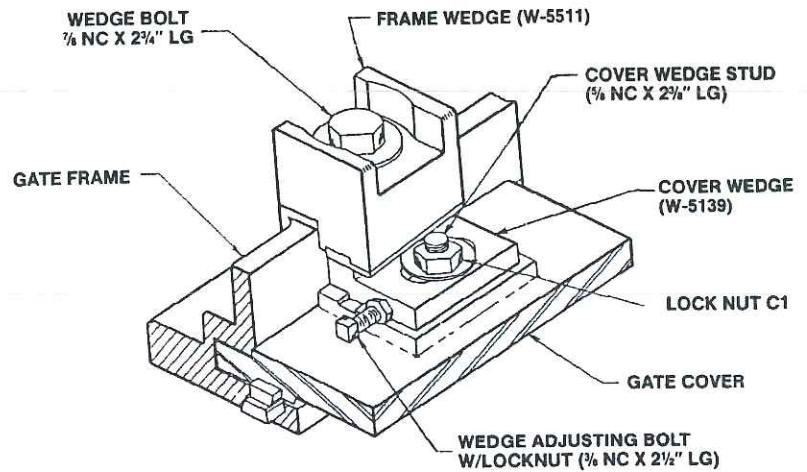


Figure 9

PROCEDURE FOR ADJUSTING SIDE WEDGES ON P-32 SLUICE GATES

1. Loosen wedge locking nut on guiderail (A1).
2. Loosen adjusting screw locknut (A2).
3. Tighten adjusting screw (A3) until proper seating is attained.
4. Tighten wedge locking nut (A1).
5. Tighten adjusting screw locknut (A2).

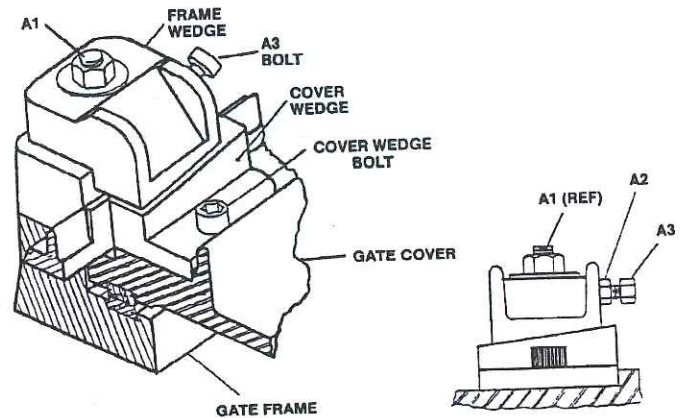


Figure 10

PROCEDURE FOR ADJUSTING TOP AND BOTTOM WEDGES ON SERIES 4000 SLUICE GATES

1. Loosen locking bolt slightly (T1) (L1).
2. Loosen adjusting screw lock nut (T2) (L2) [$\frac{3}{8}$ " nc hex].
3. Tighten adjusting screw until proper seating is attained. (T3) (L3) [$\frac{3}{8}$ " nc x $1\frac{3}{4}$ " lg hex hd bolt]
4. Tighten locking bolt (T1) (L1).
5. Tighten adjusting screw lock nut (T2) (L2).

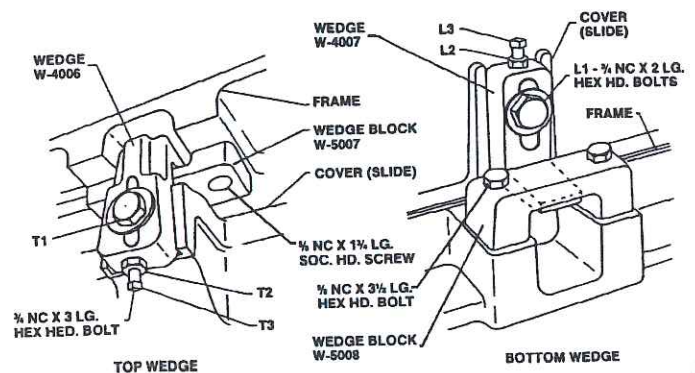


Figure 11

PROCEDURE FOR ADJUSTING TOP AND BOTTOM WEDGES ON SERIES 5000/7000 SLUICE GATES

1. Loosen locking bolt slightly (T1) (L1) [$\frac{3}{4}$ " nc x 3" lg hex hd bolt].
2. Loosen adjusting screw lock nut (T2) (L2) [$\frac{1}{2}$ " nc hex].
3. Tighten adjusting screw until proper seating is attained (T3) (L3) [$\frac{1}{2}$ " nc x 2" lg sq. hd. set screw].
4. Tighten locking bolt (T1) (L1).
5. Tighten adjusting screw lock nut (T2) (L2).

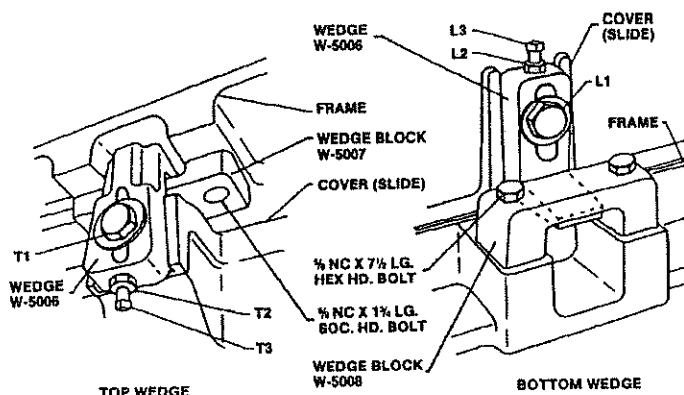


Figure 12

WEDGE ADJUSTMENT ON FLUSHBOTTOM HEAVY DUTY SLUICE GATES

1. If wedge adjustment is necessary on a flushbottom sluice gate, a slightly different procedure is required.
 - a. Loosen all wedges as described previously.
 - b. Loosen slide until it compresses the resilient seal enough for proper seating.
 - c. Adjust all wedges as described previously.

WEDGE ADJUSTMENT SEQUENCE

NOTE: All wedges should seat with equal pressure. If all wedges should need adjusting, the sequence shown is suggested:

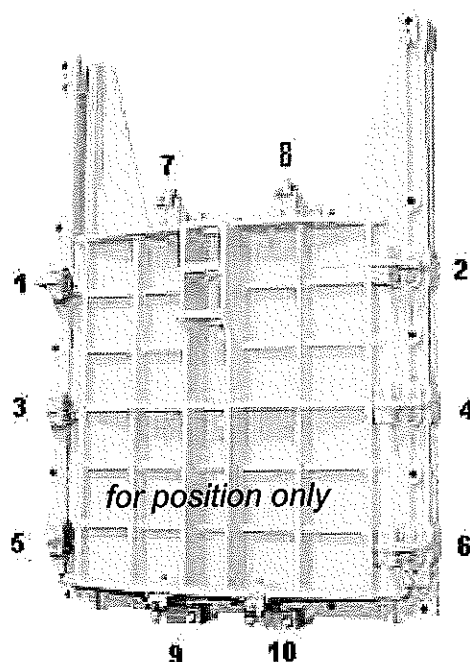


Figure 13

LUBRICATION RECOMMENDATIONS

1. Grease machined iron surfaces and bronze seats and wedging surfaces with NO-OX-ID, manufactured by Dearborn Chemical Division, W.R. Grace and Co. or equal.
2. Grease stainless steel seats and wedging surfaces with Never-Seez, manufactured by Never-Seez Corp. or equal. For best results mix Never-Seez with an equal portion of ten-weight oil.
3. Lubricate Waterman Gate Lifts with Lubriplate, Type 630-AA, manufactured by Fisk Brothers Refining Co. or equal, at three month intervals. A one gallon can is a one to two year supply for three lifts.

Note: Use caution when filling pinion shafts on Type 3 lifts. DO NOT OVER FILL.

1.1.2. Operating Plan for Hydraulic Control Structure as complete system

A. HCS Structural Design Criteria

- a) The hydraulic control structures include the structures and equipment necessary for filling and emptying the casting basin in a controlled manner and consist primarily of an intake structure and a discharge pump shed structure.

- i. Dead Load, DC

- Submersible pumps weighing 1,200 lbs each

- ii. Live Loads, PL

- Roof live load of 20 psf on the discharge pump shed roof

- Platform live load of 100 psf on pump access platform

- See Section 7 of the Design Basis Manual in Appendix A for a full breakdown of the loading criteria and load factors.

B. HCS Mechanical Design Criteria

- a) Flooding of Basin by Gravity

- i. Capable of drawing water from the adjacent waterway at all tides

- Invert of 48-inch intake pipes set at -8.33' (MLLW). Lowest observed tide is -3.35'. Pipes are submerged during all tides.

- 48-inch pipes allow the basin to fill in a relatively short period of time for all planned cycles. Time is dependent upon tides and pontoons present in basin. These large diameter pipes also provide greater filling flexibility for unknown future operations.

- ii. Gravity flooding occurs through both pipes. Pumping is not necessary to achieve float out water surface elevations. Flood times are dependent upon float out cycle and tides. Flooding of basin via 48" pipes and through the main gate can be achieved to allow sufficient float out time for each of the six planned cycles for the majority of predicted tides. All tidal data used is 2012 predicted data from NOAA Tide Station 9441187, Aberdeen, WA

- Float out is assumed to take no longer than approximately 6 hours from when the pontoons lift off until they are completely loaded out.

- Gate removal is assumed to take approximately 3 hours from the time the basin water surface equilibrates with the channel water surface and the gate removal process is initiated until the basin gate is clear and ready for float out.

Gate removal is assumed to take approximately 3 hours from the time the basin water surface equilibrates with the channel water surface and the gate removal process is initiated until the basin gate is clear and ready for float out.

- iii. Intake fish screen is sized to accommodate a 200 cfs uniform flow. Sluice gate opening is adjusted to control the flow through the fish screen. As the tide falls and basin fills the sluice gate is opened further to maintain a uniform flow rate of 200 cfs or less.

Screen is sized per the WDFW screening requirements technical assistance document. Screen is profile bar suitable for screening out fry.

b) Pump Assisted Emptying of Basin

- i. Pumps are utilized after main gate is replaced. Pumps are capable of emptying basin in approximately 12 hours from MLLW. This time will vary due to the water levels not being at MLLW when the basin gate is placed. A 12 hour emptying time provides a balance between time, space for pumps/size of pumps and availability of rental pumps. No time allotment for fish handling has been included.
- ii. Pump screen is sized to accommodate a 27000 gpm flow. This will accommodate six nominal 4000 gpm pumps at all expected pumping heads.

Screen is sized per the WDFW screening requirements technical assistance document. Screen assumed for design is profile bar suitable for screening out fry.

c) Capable of Gathering and Removing Fish

- i. A fish box is provided to meet ESA requirements as part of RFP Commitments
 - (1) Fish box is used to transport fish from the basin to the channel. Fish are herded into the box where a crane will then be used to move the box from the basin to the channel to return the fish to Grays Harbor.
 - (2) Fish box size is a result of conversations and meetings with WDFW
 - (3) Fish box has a screened cover to prevent fish from jumping out while being returned to the channel and is aerated to maintain the dissolved oxygen levels prescribed by WDFW in the HPA.
 - (4) The operator may choose to include a plate ramp from the casting basin floor to the fish box if required.

C. HCS Equipment

a) Sluice gates -

Sluice gates are Waterman Industries S-5000 cast iron sluice gate as indicated on drawing HS19 in Appendix B.

b) Pumps

Pumps are Godwin Sub-Prime GSP portable electric submersible pump model SV.

1.1.3. Operating Plan for Gate as complete system

A. Setting/picking of gate

The following instructions and procedures assume that the initial installation and fit up have been performed in accordance with the instructions and procedures outlined on as-built drawings G33 to G36 in Appendix B. The casting basin operator shall record necessary locations from the initial installation and fit up here in Appendix H of this manual:

a) Preparation

Clean the gate bearing surfaces of debris and obstructions that could prevent safe gate assembly and installation or affect the ability of the truss to bear or seal correctly.

Install the two basin-side hydraulic jacks, the two channel-side hydraulic jacks, and the gate guides on the jambs.

With the truss assemblies still on land, inspect and, if necessary, repair the seals and fittings to ensure a watertight fit. Inspect and, if necessary, adjust the spring assemblies to ensure they conform with values recorded above from the initial installation and fit up.

The balance of the assembly is assumed to begin during a low tide to maximize the visibility while positioning truss 1 and truss 2.

b) Stage 1

Lift, position and lower truss 1 to rest on the casting basin slab such that the gate grid A is located 5 1/2 inches south of the perimeter seal plate on both jambs. See as-built drawing G34 in Appendix B. Lifting shall be performed in accordance with as-built drawing G36.

c) Stage 2

Lift and position truss 2 over truss 1.

Lower truss 2 to engage the type 1 alignment pins located on truss 1 at grids A3 and A7. See as-built drawing G34 in Appendix B.

Confirm that truss 2 is plumb and square with respect to truss 1, and that the shear keys are partially engaged. Adjust as required.

Lower truss 2 to rest on truss 1, ensuring all shear keys alignment pins are engaged.

d) Stage 3

Lift and position truss 3 over truss 2.

Lower truss 3 to engage the type 1 alignment pins located on truss 2 at grids A3 and A7. See as-built drawing G34 in Appendix B.

Confirm that truss 3 is plumb and square with respect to truss 2, and that the shear keys are partially engaged. Adjust as required.

Lower truss 3 to rest on truss 2, ensuring all shear keys are engaged.

Pull the assembled gate towards the jamb using the basin-side hydraulic jacks. Increase the loads in the jacks to set the primary seal against the sill

The tie rods at grid A shall be tensioned until the seal stops are in contact. The tie rods at grid B shall be snug tight.

The screw jacks at grid B shall be extended to the jamb and hand tightened.

e) Stage 4

Install the catwalk.

f) Stage 5

After the Casting Basin has been dewatered, install the gate ribbon anode on the dry side of the gate.

B. Removal of Gate

To remove gate, the water heights on either side of the gate must be equal. All blocking and screw jacks used to maintain gate location in service are removed. The vertical tie rods at grid A and B shall be removed. The catwalk shall be removed from the top of the gate. The corrosion protection anode ribbon shall be removed from the dry side of the gate.

At this point, the gate is pushed away from the sill and jamb. Grid A shall be located 5 ½" south of the perimeter seal plate on both jambs. The gate segments are then lifted and removed. Hydraulic jacks located behind the Grid A – T1L truss chord will react against the outside face of the jambs to provide this movement.

C. Gate Storage

When not in use, the gate is to be stored uncovered on site, blocked on dunnage per drawing G36 in Appendix B and stored in the upright position. Miscellaneous parts are also stored with the gate.

D. Inspection of Gate between cycles

A visual inspection is to be conducted each time the basin gate is removed. The condition of each element is noted in the inspection log. See 1.1.3G for more information regarding inspection

E. Gate Structural Design Criteria

a) Operational Loading

i. Load Cases

The gate is subject to vertical and lateral loads in the operational condition. The vertical loads include dead load of the gate, buoyancy created by the perimeter seal and closed tubular members, a live load on the catwalk located at the top truss of the gate and forces induced by vertical seismic accelerations. The horizontal loads include hydrostatic loads, wind loading, wave loading, thermal movement/restraint and transverse and longitudinal forces induced by seismic accelerations. See Section 8 of the Design Basis Manual in Appendix A for a detailed description of the gate loads and load combinations.

The catwalk design live load is 85 psf.

F. Gate Materials and Maintenance

a) Gate Coating System

i. General

(1) Scope

This section applies to the required procedures for inspection and repair of the Sherwin-Williams corrosion coating protection system consisting of Corothane I Galva-Pac Zinc Primer and two coats of Dura-Plate 235 Epoxy. When in service, the gate structure is exposed to constant immersion to salt and brackish water on the outside face and exposure to salt spray, salt air and rainfall on the inside/dry side.

(2) Coating inspection and repair procedures address the following defects:

- a. Evidence of rust or corrosion of substrate steel.
- b. Delamination, flaking or blistering of the coating.
- c. Mechanical damage to the coating system.
- d. Excessive chalking or erosion of the top coat color and the intermediate coat color.

(3) References

- a. SSPC – Society for Protective Coatings
 - 1. SSPC¹ SP-10 Near White Metal Blasting

¹ SSPC – The Society for Protective Coatings
40 24th Street, 6th Floor Pittsburgh, PA 15222-4643
(412) 281-2331

2. SSPC SP-11, Power Tool Cleaning to White Metal with 1 mil profile
3. SSPC SP-12, Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating
4. SSPC PA-2, Measurement of Dry Paint Thickness with Magnetic Gages.
5. SSPC Technology Guide 15, "Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.

b. ASTM² International

1. ASTM E 337, "Test Method for Measuring Humidity with a Psychrometer"
2. ASTM D 4414, "Standard Practice for Measurement of Wet Film Thickness by Notch Gages"
3. ASTM D 4263, "Test Method for Indicating Oil or Water in Compressed Air"
4. ASTM D 4417, "Test Method for Field Measurement of Surface Profile of Blast Cleaned Steel"

ii. Products

- (1) All products (coating and thinners) used for this coating repair are from Sherwin-Williams and conform to the following.

- a. Primer - Corothane I Galva-Pac Zinc Primer
- b. Intermediate and Finish Coats Dura-Plate 235 Epoxy

(2) Delivery, Storage and Handling

- a. Deliver products to the job site in manufacturer's original, unopened containers bearing manufacturer's name and label and the following information:
 1. Product name
 2. Product description (generic product classification)
 3. Manufacturer's lot number

² ASTM International
100 Barr Harbor Drive West Conshohocken, PA 19428-2959
(610 – 832-9585)

4. Color

- b. Store materials in sealed original manufacturer's containers. Store materials in a protected area out of direct sunlight. Keep containers clean and undamaged. Adhere to manufacturer's published storage temperature and shelf life recommendations. Protect all materials from freezing.

iii. Execution

(1) Inspection

- a. Prior to the start of the inspection, the gate is removed from the casting basin entrance, disassembled into three subassemblies, and stored on land. Each subassembly is potable-water washed to remove all marine growth, dirt, and debris that prevent visual inspection of all coated surfaces. Washing of the gate shall be coordinated with the maintenance cleaning section of this operations and maintenance manual.
- b. Results of the visual inspection is documented. Defects found are identified as to type, and their location mapped on the appropriate gate design plan sheets. These data are required to facilitate accurate location of all required repairs. Once a repair is made, the document is annotated to reflect the repair type and date, and maintained as a record in the O&M Manual to be used as input to subsequent inspections.
- c. Inspections shall be completed by trained personnel certified as corrosion inspectors by the National Association of Corrosion Engineers (NACE). NACE certifications shall be maintained as a record in Appendix H of the O & M Manual.
- d. As a minimum, a complete inspection of all coated surfaces is completed in intervals not exceeding 2 years. When any inspection is completed at an interval of less than two years from the previous inspection, the subsequent inspection need not occur sooner than the minimum 2 year interval. The inspection is visual in nature and is conducted per the National Bridge Inspection Standards (NBIS). All truss members and the basin side of the barrier wall can be inspected while the gate is in place and is dry. The front side of the barrier wall is visually inspected by boat at low tide. The gate shall be fully inspected each time it is removed from the casting basin.

(2) Repair

- a. Repairs following welding, burning or other mechanical fixes shall be properly prepared for coating by grinding off weld splatter, sharp edges, slivers, slag, etc. that render a relatively smooth surface.

- b. Coating repairs may be of such size as to generate considerable volume of dust and water. The facility operator shall assess the need for proper environmental controls, including; full enclosure/containment, water runoff and collection means, dust collector(s), ventilation, etc. Full compliance with Washington Dept. of Ecology requirements are to be followed.
- c. All surfaces to be repaired shall be washed with clean potable water to remove non-visible contaminants (salts).
 - 1. For small repair locations, hand wash with clean water and clean rags, changing the water frequently and rotating and rinsing the rags.
 - 2. For large areas, pressure wash to SSPC SP-12, (LP WC) at a minimum of 5,000 psi at the nozzle.
- d. Following water washing, locations to be repaired shall be tested in accordance with SSPC Technology Guide 15 using retrieval method Class A, Method A1 or A2. The number of tests and their locations shall be determined by the Engineer. The criteria for an acceptably clean surface shall be per SSPC SP-12, NV-2 (equal to or less than 7 $\mu\text{g}/\text{cm}^2$ (0.0007 grains/in²) of chloride contaminants, equal to or less than 10 $\mu\text{g}/\text{cm}^2$ (0.001 grains/in²) or soluble ferrous ion levels, or equal to or less than 17 $\mu\text{g}/\text{cm}^2$ (0.0017 grains/in²) of sulfate contaminants.
- e. Following potable water cleaning, the repair locations shall receive surface preparation in accordance with the following, based on the type of repair:
 - 1. SSPC SP-10 abrasive blasting for large surface area repairs requiring complete coating defect removal down to the bare substrate.
 - 2. SP-11 power tool cleaning for small surface area repairs requiring complete coating removal down to the bare substrate.
 - 3. SP-7 brush off blast cleaning for Dura Plate 235 surface coating only removal (not including the primer coat) due to peeling or flaking. The remaining coating (primer and/or intermediate), after brush off blasting, shall be etched to provide a mechanical bond with the new topcoat. SP-7 abrasive blasting shall be used at reduced pressure to reduce micro-fracture or cracking of the existing coating.
- f. The profile after SP-10 or SP-11 cleaning shall be sharp and angular and not less than 2 mils as measured per ASTM D4417. The area of repair shall extend out until adhered/tight existing coating is achieved but not less than 3 in. sq. for small repairs.

- g. The existing coating all around the repair area shall be feathered back at least 1 inch to facilitate a smooth transition and minimize lifting/curling of the existing coating.
- h. Comply with coating system manufacturers written installation procedures and individual product data sheet application bulletins.
- i. Verify that all environmental conditions are within the Sherwin-Williams product data sheet for the materials to be applied.
- j. Application of the repair coating shall be sufficient to achieve the dry film thickness as follows:

Primer, Corothane I Galva-Pac Zinc Primer	3 – 4 mils DFT
Intermediate Dura-Plate 235 Epoxy	6 – 8 mils DFT
Finish Coats - Dura-Plate 235 Epoxy	<u>6 – 8 mils DFT</u>
TOTAL	15–20 mils DFT

iv. Testing

- (1) The facility operator or authorized representative shall inspect the repair work as it is progressing and perform a final inspection.
- (2) If test results indicate noncompliance with this specification, non-compliant coating shall be removed and re-applied in conformance with this specification.
- (3) The minimum test requirements and measurements shall be in compliance with ASTM F941 and consist of the following and corrected if deficient or lacking.
 - a. Proper dry film thickness per coat and total thickness
 - b. No evidence of visual pinholes or holidays
 - c. No evidence of lifting, delamination or curled edges.
 - d. No evidence of embedded foreign matter
 - e. No evidence of uncured material.

b) UHMW Bearings

i. General

The UHMW Bearings are affixed to the gate at the following locations: On the inside face of truss chords T1U, T2L, T2U, T3L and T3U at Grids 1 and 9 (a total of 10 bearings) and on the bottom side faces of the T1 truss vertical supports located at Grids 3 and 7 (a total of 4 bearings). Each UHMW bearing assembly contains a UHMW bearing pad and is affixed to the gate by bolted connections, and each is removable for inspection. Each UHMW bearing pad is part of

bearing assembly that includes a shim pack. Minor amounts of bearing wear can be accounted for without requiring bearing pad replacement by adjusting the shim packs as described in the following. Bearing design information and installation locations can be found on the gate design plan drawings G05, G11, G12, G14 - G16 in Appendix B.

ii. Inspection

A visual inspection shall be made of each UHMW bearing whenever the gate has been removed from the casting basin and is stored on land. The visual inspection shall be made to determine if the bearings are worn, cracked or crushed. Bushings that are abraded or worn such that the radiused surface of the bearing has been reduced in thickness shall be measured to determine the thickness reduction and compared to the design thickness. The UHMW pads shall be replaced when there is $\frac{3}{4}$ " or less of clearance between the surface of the pad and the top of the bolt head.

iii. Maintenance

Cracked or crushed bearings shall be replaced. Worn bearings (bearing height less than design bearing height) shall be maintained as follows:

- (1) Truss Chord and Vertical Support Bearings: Remove the bearing and determine the amount of wear (thickness reduction). The bearings shall be supported by 12" x 12" dunnings at the bearing locations. Adjust shim pack to compensate for the loss in the design height of the UHMW. When the amount of wear exceeds shimming capacity, replace the UHMW bearing.
- (2) Special attention is to be placed on the UHMW Vertical Support Bearing regarding an increase in friction coefficient that accompanies a worn or abraded surface. The bearing design is based on limiting the friction coefficient between the UHMW pad and the stainless steel embed plate in the casting basin slab to a value of 0.20. Should surface wear of the UHMW pad at the vertical support bearings indicate that the friction coefficient will exceed 0.20, the UHMW pad should be replaced. Indications of significant surface wear would be rutting or extensive scraping of the UHMW bearing pad.

c) Natural Rubber Seals

i. General

There are two natural rubber seal types affixed to the gate as follows: a perimeter seal that minimizes leakage at the gate barrier wall interface with the concrete sill face and the concrete jambs, and two intermediate seals that minimize leakage at the barrier wall horizontal openings located between trusses T1 to T2 and T2 to T3. Each natural rubber seal includes a molded 30-Durometer natural rubber element that encapsulates a stainless steel reinforcing plate. Each seal type (P= Perimeter, N = Intermediate) is an assembly of a series of individual segments that are affixed to the barrier wall by

bolted connections, and can be removed for inspection, repair or replacement. Gate seal design information and installation locations can be found on the gate design plan drawings G23 – G29 in Appendix B.

ii. Inspection

- (1) Prior to the start of the inspection, the seals shall be potable water washed to remove all marine growth, dirt, and debris that prevent visual inspection of all the seal surfaces including the heads of the mounting bolts.
- (2) During all periods when the gate is in service, visual checks should be made to record seal locations where leakage is occurring. This information should be used during scheduled inspections to prioritize the inspection effort to determine whether repair or replacement of specific seal segments is necessary.
- (3) During construction of the pontoons for the SR520 Bridge Replacement Project, the seals should be visually inspected whenever the gate is stored on land between casting basin cycles.
- (4) As a minimum a visual inspection shall be completed of all seals in intervals not exceeding 1 year. Inspection can be completed from the basin side and examining for signs of leaks, cracking or seal deterioration. Similar inspection shall be made from the waterside via boat. Seals shall be inspected each time the gate is removed from the casting basin.
- (5) Each visual inspection shall be made to determine if the natural rubber seals are worn, cracked, or crushed, if the rubber is showing evidence of material deterioration such as Ultra-violet (UV) light, sulfate attack, or mechanical deterioration such as tearing, crushing or creep, and if the bolted connections are damaged. If there is excessive leakage of the seal, or a crack depth in the rubber propagating more than ¼" deep, the seal section shall be replaced.
- (6) All observed inspection items shall be documented by identifying the type of deterioration and its location on the inspected seal, and mapping these locations on the appropriate gate seal design plan sheet. These data are required to facilitate subsequent inspections and to identify the location of all repairs. Once a repair is made, the document shall be annotated to reflect the repair made and the date it was made. This inspection document shall be maintained as a record in Appendix H of the O&M Manual.

iii. Maintenance

- (1) Seal segments that show evidence of cracking, bulging, dimensional instability, creep, and alteration of the natural rubber mechanical properties such as stiffness and elasticity, and those that have a record of leaking, should be replaced. Replacement should be accomplished only when the gate has been disassembled and the three truss sections T1, T2 and T3 are stored on shore.

- (2) Replace the segment by removing the nuts from the attachment threaded studs and removing it from its attachment on the barrier wall. In some instances, it may be necessary to loosen or remove an adjacent seal segment to replace a damaged segment.
- (3) Inspect the threaded stud connections for signs of corrosion, overload or wear. Galvanized threaded studs, nuts and washers that show evidence of severe corrosion should be replaced.
- (4) Threaded studs that require replacement shall be removed from the barrier wall structure without damaging the steel member to which they are welded. Flame cutting shall not be used. Remove all material that may inhibit mounting of the replacement threaded stud, and weld the replacement stud to the steel member. Locally remove existing gate marine coating from the area to be welded.
- (5) Weld the threaded stud to the gate member in accordance with the details shown in the gate design plan set.
- (6) Repair any local galvanize damage on the stud in accordance with ASTM A 780, Annex A.1. The zinc based repair stick shall be "Zalcon Repair Alloy", and the final coating thickness shall be 4 mils minimum.
- (7) Repair any damaged or removed marine coating on the gate member in accordance with Section: Gate Coating System.
- (8) Install replacement seal segment and any adjacent segments removed or loosened to gain access.

d) Screw Jack Assembly

i. General

A total of ten screw jack assemblies are mounted on the gate Grid B truss chords (5 each at Grids 1 and 9). The screw jack assemblies are used to clamp the gate to the back faces of the east and west jambs to restrain the gate from outward movement during seismic loading. The adjustable stroke of the screw jack allows the jacks to be positioned for easy installation of the gate. Each screw jack assembly contains a spherical washer set to prevent overstress of the screw jack assembly that may be caused by thermal expansion and contraction of the gate, and seismic loading. The screw jack design and instructions for adjusting the screw jacks to function correctly during gate installation and while in service is described on the gate design plan drawings G05, G012, G18, G33 and G35 in Appendix B.

ii. Inspection

The screw jacks shall be cleaned and inspected each time the gate is removed. The screw jack assemblies shall be cleaned with potable water to remove all marine growth, dirt and debris that prevents visual inspection of all the

surfaces. The assembly shall be inspected for signs of corrosion overload or wear.

All observed inspection items shall be documented by identifying the type of deterioration and its location on the inspected assembly, and mapping these locations on the appropriate design plan sheet. These data are required to facilitate subsequent inspections and to identify the location of all repairs. Once a repair is made, the document shall be annotated to reflect the repair made and the date it was made. This inspection document shall be maintained as a record in Appendix H of the O&M Manual.

iii. Maintenance

Pipes, threaded rods, nuts and washers that show evidence of severe corrosion should be replaced.

e) Belleville Spring Assembly

i. General

Thirty -two spring assemblies are mounted at the base of the bottom gate section. The springs are used to hold the gate against the sill to engage the seals. Spring Assembly design information and installation locations can be found on the gate design plan drawings G14, G15, G20, G21, G33, and G34 in Appendix B.

ii. Inspection

- (1) Clean and inspect the outside of all springs every time the gate is pulled.
- (2) Prior to the start of the inspection, the springs shall be potable water washed to remove all marine growth, dirt, and debris that prevent visual inspection of all the spring surfaces.
- (3) Disassemble two different springs each time the gate is pulled and inspect the insides of the spring discs.
- (4) Inspect the assembly for signs of corrosion, overload or wear.
- (5) All observed inspection items shall be documented by identifying the type of deterioration and its location on the inspected assembly, and mapping these locations on the appropriate design plan sheet. These data are required to facilitate subsequent inspections and to identify the location of all repairs. Once a repair is made, the document shall be annotated to reflect the repair made and the date it was made. This inspection document shall be maintained as a record in Appendix H of the O&M Manual.

iii. Maintenance

Threaded rods, nuts and washers that show evidence of severe corrosion should be replaced. Spring discs that are cracked or show signs of stress corrosion shall be replaced.

f) Shear Transfer Fittings and Thread Rods

i. General

Shear transfer fittings and thread rod design information and installation locations can be found on the gate design plan drawings G10, G14, G15, G17, G29, G34, G35 in Appendix B. The shear fittings and tie rods are an important part of the gate design that allows the gate to function as one system.

ii. Inspection

Shortly before flooding the basin or removing the gate, check all shear fittings for gaps between bearing pads. Shear fittings and thread rods shall be cleaned with potable water to remove all marine growth, dirt and debris that prevents visual inspection of all the surfaces.

iii. Maintenance

Inspect the threaded rod connections for signs of corrosion, overload or wear. Galvanized threaded rods, nuts and washers that show evidence of severe corrosion should be replaced. Shear fittings that show a gap shall be replaced when the gate is removed from the basin.

g) Maintenance Cleaning

i. General

The gate structure shall be cleaned each time the gate is removed. The truss members and barrier wall shall be cleaned with potable water to remove all marine growth, dirt and debris that prevents visual inspection of all the surfaces. All miscellaneous parts of the gate, including seals, screw jacks, Belleville springs, coatings, tie rods and shear keys shall be cleaned per the appropriate section of this O & M manual. Care shall be taken when cleaning not to damage the protective coating on the gate or other miscellaneous parts.

h) Gate Inspection Checklist

The following items shall be inspected each time the gate is removed from the basin. This list is not intended to replace any portion of the O & M Manual, rather provide the contractor with a checklist of items that shall be inspected. The inspection of the gate system is not limited to the items below. All inspection and maintenance shall be per this Operations and Maintenance Manual.

i. Gate Coating System

ii. Gate Truss Members and Connections

- iii. Gate Barrier Wall
- iv. UHMW Bearings
- v. Natural Rubber Seals
- vi. Screw Jack Assembly
- vii. Belleville Spring Assembly
- viii. Shear Transfer Fittings and Thread Rods

i) Gate Critical Repairs

The following list outlines the critical repairs that may be required on the gate system. This list is not intended to replace any portion of the O & M Manual, rather provide the contractor with a checklist of items that shall be repaired if there is significant damage. The repair and maintenance of the gate system is not limited to the items below. All inspection and maintenance shall be per this Operations and Maintenance Manual.

i. Gate Coating System

Mechanical damage to the coating system which leaves large areas of metal exposed shall be repaired.

ii. UHMW Bearings

Damaged bolted connections, excessive wear of the pad, or an indication of an increased coefficient of friction shall require replacement of the bearings.

iii. Natural Rubber Seals

Damaged bolted connections shall be replaced. Cracks deeper than $\frac{1}{4}$ ", excessive leakage of the seal, excessive deformation or other evidence of material degradation shall require that section of the seal be removed and replaced.

iv. Screw Jack Assembly

Pipes, threaded rods, nuts and washers that show evidence of severe corrosion should be replaced.

v. Belleville Spring Assembly

Threaded rods, nuts and washers that show evidence of severe corrosion should be replaced. Spring discs that are cracked or show signs of stress corrosion shall be replaced.

vi. Shear Transfer Fittings and Thread Rods

Galvanized threaded rods, nuts and washers that show evidence of severe corrosion should be replaced. Shear fittings that show a gap shall be replaced when the gate is removed from the basin.

1.1.4. Structural Design Criteria

A. Tower Gantry Crane Foundations

- a) The tower gantry crane foundations are pile supported structures that allow a rail mounted tower gantry crane to pick, trolley, rotate and set objects to aid in the construction of the pontoons on the casting basin slab.

i. Tower Crane (DL_{TC})

The design tower crane is a Potain MD560A on a rail traveling chassis. The design crane height is 224' with a 263' boom. Vertical and horizontal reactions are provided by the crane manufacturer.

Tower cranes require a spacing of at least 60' when in use.

ii. Crawler Crane (DL_{2250})

The design crawler crane is a Manitowoc 2250 Series 3 with a 190' Boom or Liebherr LR 1300. It is assumed that while picking the treads are parallel to the longitudinal crane beams. Crawler Crane Loads were obtained from the Manitowoc Ground Bearing Pressure Estimator Computer program. Crawler cranes require crane mats upland when crawling onto the trestle; see the Geotechnical Report for more information. See CB 1A in Appendix B for allowable crane picks and radii for stationary and crawling picks.

iii. Wind (WS)

The design wind speeds for the tower crane represents a nominal 3 second wind gust at 33' above the ground level. Wind loading is determined in accordance with ASCE 7-05, Exposure Category C. The design wind speeds are as follows:

Load Case 1 represents wind speeds up to 45 mph

Load Case 2 represents wind speeds up to 80 mph

Load Case 3 represents wind speeds up to 94.5 mph. The wind speed corresponding to the site design wind speed of 105 mph reduced by a factor of 0.9 in accordance with SEI/ASCE 37-02 assuming the cranes are temporary and in service for 5 years or less. Note that wind speeds over 80 mph require a positive tie down to the crane beams.

- iv. See Section 7.6 of the Design Basis Manual in Appendix A and as-built drawings CB1 and CB1A in Appendix B for a detailed description of the crane loads and load combinations.

B. Gate Picking Crane Trestle

- a) Loads

i. Live, PL

Pedestrian Live Load of 85 psf along the top walkway.

ii. Crane Loads, CR

The trestle is designed to support the following cranes to allow for the removal of the gate structure: Manitowoc 2250 crawler crane, GMK 7550 truck crane, or a Demag 1200 TC truck crane.

Pedestrian Live Load of 85 psf along the top walkway.

iii. Crane Loads, CR

The trestle is designed to support the following cranes to allow for the removal of the gate structure: Manitowoc 2250 crawler crane, GMK 7550 truck crane, or a Demag 1200 TC truck crane.

iv. See Section 7.3 of the Design Basis Manual in Appendix A and as-built drawing BH01 in Appendix B for a detailed description of the trestle loads and load combinations.

C. Channel Dolphins

- a) The launch channel dolphins shall assist in the launching of the pontoons, berthing and mooring of the pontoons, and guidance and turning assistance for the pontoons.
 - i. Wind Loading: Easterly 40.0 mph, 3 second wind gust using AASHTO Equation 3.8.1.2.1-1 and AASHTO Wind Load (WS) load factor. This wind load corresponds to a 2 year return period per the Coastal Engineering Report.
 - ii. Wave Loading: $H_m0 = 1.0'$ and $TP = 1.9$ seconds using the AASHTO Wind Load (WS) load factor. Wave heights and periods are per the Coastal Engineering Report.
 - iii. Current Loading: Flood tide design current = 2.0 knots. Ebb tide design current = 3.0 knots per the Coastal Engineering Report.
 - iv. Berthing Loading: 0.31 ft/sec sheltered berthing velocity as defined by UFC 4-152-01. Total berthing energy = 31 kip-ft.

D. Casting Basin Fenders

- a) The casting basin fenders shall assist in the launching of the pontoons out of the casting basin and into the launch channel.
 - i. Wind Loading: Easterly 40.0 mph, 3 second wind gust using AASHTO Equation 3.8.1.2.1-1 and AASHTO Wind Load (WS) load factor. This wind load corresponds to a 2 year return period per the Coastal Engineering Report.

- ii. Berthing Loading: 0.31 ft/sec sheltered berthing velocity as defined by UFC 4-152-01. Total berthing energy = 31 kip-ft.

E. Casting Basin Slab

a) Design Approach

The casting basin piles are designed to carry the vertical loads imparted from and to the casting basin slab in addition to providing the primary lateral shear support for the gate, sill, jamb and bulkhead wall structures under hydrostatic and seismic loading conditions.

b) Loads

i. Dead Loads

Pontoon Load

Pontoons have the same load factors and appear in the same combinations as that of dead load due to non-structural components and non-structural attachments.

The basin floor is designed for the weights of the pontoons to be built, and shall incorporate pattern loading to determine the maximum effects of the pontoon on the basin floor. See as-built drawings CB1A and CB2 in Appendix B for pontoon loading on the basin floor. The design pontoon loads are as follows:

- A uniform load of 1000 psf over 60 foot by 100 foot footprint with 20 feet -0 inches minimum clear spacing between each 60 foot by 100 foot footprint.
- A uniform load of 1150 psf over a 50 foot by 100 foot footprint contained within each 60 foot by 100 foot footprint described above.
- A uniform load of 1150 psf over the entire floor.

ii. Live Loads

Construction live load of 40 psf on the pontoons

Pontoon formwork and bracing loads

HL-93 Vehicular live load

Pedestrian live load of 85psf over the basin floor

- iii. See Section 7.2 of the Design Basis Manual in Appendix A and as-built drawings CB1 and CB1A in Appendix B for a detailed description of the casting basin slab loads and load combinations.

F. Casting Basin Sill and Jamb

a) Design Approach

i. Lateral Load Path (Towards Basin or Channel)

Gate loads (hydrostatic, seismic, and wind) are reacted through bearing points located along the vertical face of the jambs and running along the vertical face of the outer sill edge beam

- Overturning loads at each jamb are resisted by the pile group under the jamb foundation.
- Shear loads at each jamb and along the sill are resisted by the casting basin slab piles (sill and jamb foundation piles inclusive).
- At the bulkhead wall, overturning loads are resisted by the piles directly below the wall. Shear loads from the wall are resisted by the casting basin slab piles.

ii. Vertical Load Path

Gate loads are transferred to the sill foundation at 4 discrete bearing points located at the intersections of gate grids 3 and 7 and gate grids A and B. These loads are resisted by the sill foundation piles.

iii. See Section 7.2 of the Design Basis Manual in Appendix A and as-built drawings SJ01 and SJ02 in Appendix B for a detailed description of the casting basin sill and jamb loads and load combinations.

(1) Vehicle live load, AASHTO HL-93

(2) Live, PL

a. Platform live load of 85 psf

(3) Pontoon, PN

a. A uniform load of 1150 psf over the entire floor.

G. Casting Basin Bulkhead Walls

a) Loads

i. Live, PL

Pedestrian Live Load of 85 psf along the top walkway.

ii. See Section 7.3 of the Design Basis Manual in Appendix A and as-built drawings BH01 and BH02 in Appendix B for a detailed description of the bulkhead wall loads and load combinations.

H. Casting Basin Slopes

The allowable surcharge load upland of the tower crane beams shall be per as-built drawing CB1A in Appendix B and per the Geotechnical Report in Appendix F.

I. Launch Channel

- a) Maintenance dredging is required to maintain the channel's depth for float out events.
 - i. Channel shall be configured and maintained so that pontoons with a 17 ft draft can be floated through the launch channel with a minimum 1 foot clear distance between the pontoon keel and the channel bottom.
 - ii. Prior to float out, if sediment has accumulated above the bottom of the gate, the sediment shall be removed by divers, jetted out, or by other approved methods prior to gate removal. Regular maintenance dredging is recommended to prevent build-up.
- b) Hydrographic surveys are required for each dredging event. Pre- and post-dredge surveys shall be maintained as a record with this O&M Manual. Dredging cut volumes & disposal location for each dredge event shall be recorded and maintained as a record in Appendix I of the O&M Manual.
- c) See Section 10.2 of the Design Basis Manual in Appendix A and the Coastal Engineering Report in Appendix G for a complete description of the launch channel design.

J. Batch Plant Foundations

- a) Design Wind: 105mph, Exp C.
- b) Concrete: $f'_c=4000$ PSI.
- c) Pile Material: ASTM 252 Grade 35.
- d) Reinforcing Steel: ASTM A615 Grade 60 $F_y=60000$ PSI.
- e) Weld using E70XX electrodes by WABO certified and qualified welders, using AWS D1.1 procedures.
- f) Plate: ASTM A36.
- g) Steel Fabrication: per AISC 13th Edition.
- h) All concrete shall conform to ACI 318-05. $\frac{3}{4}$ " chamfer all exposed edges.
- i) All construction shall conform to IBC 2009 with Washington Amendments and Washington Health and Safety Administration.
- j) Driving Records / Blow Counts shall be maintained for the final 30' to 40' of the installation of the top 65' section of pipe.
- k) Pile Location Tolerances:

Maximum Variation from Cut-off Elevation = 2"

Maximum Out of Position = 3"

Alignment = $\frac{1}{2}$ " horizontally in 2 feet vertically from plumb

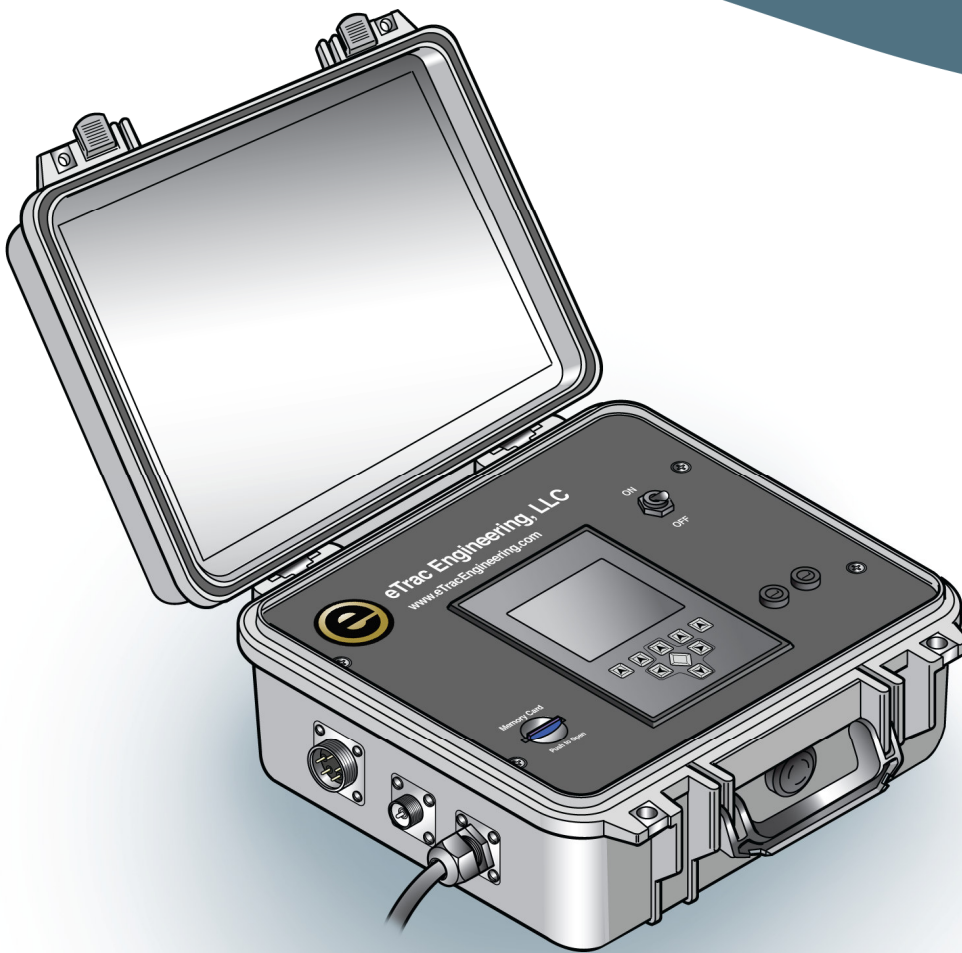
- l) The bottom 65' of the pile will be fabricated from salvaged pieces of pipe of varying length, but no one piece will be less than 10' long. Each piece will have one end beveled. The pieces will be shop welded together using full penetration single vee welds with at least a 1/8" continuous ring backer bar. The shop fabricated closed end 65' bottom piece will be driven to just above grade.

1.1.5 Owner's Manual and Manufacturers O&M for Electronic Tide Gauge

Electronic copies of wave and tidal data have been submitted as KG-WSDOT Transmittal 776. The gauge is located on the gate access at the west jamb.

TideTrac Tide Gauge

User's Guide



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About This Guide

This guide describes how to install and configure the eTrac TideTrac Tide Gauge System.

Audience

Read this document if you are installing or configuring any part of the eTrac TideTrac Tide Gauge System.

Document Conventions

Screen elements and names of softkeys appear in **bold**.

Abbreviations and acronyms are defined the first time they appear in the document.

Important terms and definitions are listed in the [Glossary](#).

Related Documents

The antenna, radios, pressure sensor, power supplies, and solar panel include their own manufacturer's documentation. Please read these related documents, as the proper set-up and maintenance of these components can affect the accuracy and performance of the Tide Gauge System.

Customer Support

A list of frequently asked questions and possible solutions are listed in the [FAQs](#).

For Technical Support contact eTrac Engineering by email at support@etracengineering.com or by phone at 415-462-0421.

Introduction

This *TideTrac Tide Gauge User's Guide* describes how to install and configure the eTrac TideTrac Tide Gauge.

Before you begin, make sure you have the following:

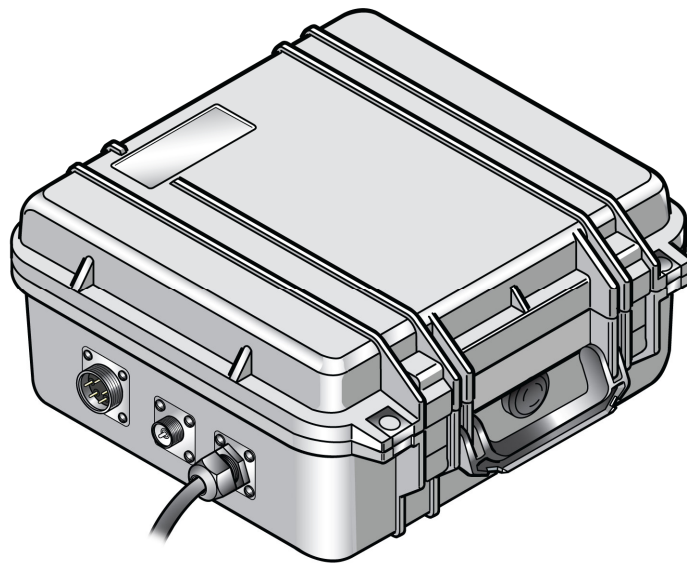
- Base Station
 - Pressure Sensor and Cable
 - Antenna for Base Station
 - Antenna Cable for Base Station
 - Power Supply (provided by customer or eTrac)
 - Power/Solar Cable for Base Station
 - Solar Panel (if purchased)
- Remote Unit
 - Antenna for Remote Unit
 - Antenna Cable for Remote Unit
 - Power Supply (provided by customer or eTrac)

Specifications and Hardware

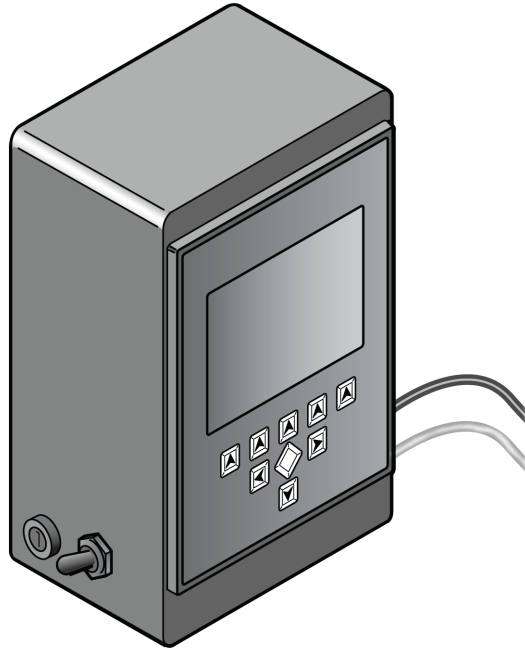
This section describes the TideTrac Tide Gauge specifications and shows the major hardware components.

Depth Range	0.00 to 30.0 feet (9.14 m) Custom sizes available for greater depths.
Accuracy	+/- 0.01 feet (3 mm, 0.12 inches)
Measurement Frequency	200Hz double-averaged input
Base Station	Waterproof and crush-proof housing with internally sealed NEMA 4 connectors with waterproof end-caps
Base Station Dimensions	13.28 x 11.63 x 6.0 inches 33.72 x 29.53 x 15.24 cm
Touchscreen LCD	Backlit 320 x 240 pixels (1/4 VGA) for both Base Station and Remote Unit
Base Power Consumption	150 ma Nominal (telemetry additional at 0.1W-45W+)
Power Options	8-28V DC + Solar (typical installations employ a 40W panel)
Standard Memory Capacity	512 Mb
Temperature Range	32° - 122° F (0° - 50° C)

Base Station



Remote Unit



Radio Modem Options

eTrac provides a standard Spread Spectrum radio. Optional radios include the Pacific Crest 2W and 35W.

Internal: Maxstream 900 MHz 1 Watt Xtend package.

External: Pacific Crest 2 Watt PDL Radio or Pacific Crest 35 Watt Booster Radio.

	Spread Spectrum	Pacific Crest 2W*	Pacific Crest 35W*
Frequency	902-928 MHz	400-470 MHz	400-470 MHz
Transmit Power	1 mW to 1 W	2 W to 11 W	3/35 W to 110
Range (line of sight)			
Omni Antenna	up to 6 miles	up to 12 miles	up to 20 miles
Yagi Antenna	up to 18 miles	up to 25 miles	up to 40 miles
Receiver Sensitivity	-110 dBm	-116 dBm	-116 dBm

***Denotes optional radios**

Pressure Sensor

This section describes how to install the pressure sensor.

Install the pressure sensor hardware on a stable manufactured platform that allows the sensor to be positioned vertically. The bottom of the stilling well must be below the low-tide or low-water mark.

Construct a Stilling Well

To ensure accurate tide measurements and extend the service life of the pressure sensor, eTrac recommends constructing a stilling well to house the sensor.

Construct a stilling well according to the following steps:

1. From a PVC pipe at least 2 inches (5 cm) in diameter, cut a length at least 3 feet (1 m) longer than the projected tide range.

Note: In areas with greater sea-state fluctuations, a larger diameter stilling well is recommended.

2. Optionally, cap the end of the stilling well or prepare the end of the well to affix the pressure sensor. If you cap the end to be submersed, be sure to drill holes that allow water to flow freely.

Note: If you cap the stilling well, the pressure sensor must not come in contact with the cap. If you do not use a cap, the pressure sensor must not extend below the bottom of the stilling well.

3. Drill holes every foot (.33 m) along the length of the PVC pipe to allow for easy water flow.
4. Attach the stilling well to the side of a stable manufactured structure such as a dock, pier head, dolphin, or piling. Install the stilling well as vertically level as possible, so that the bottom extends below the low-tide or low-water mark.
5. The bottom of the stilling well should be at least 1 foot (.33 m) below the lowest measured tide reading (MLLW). Attach the stilling well with hose clamps or galvanized hangers. Make sure that the stilling well stays firmly attached and does not move with tide fluctuations.

Install the Pressure Sensor

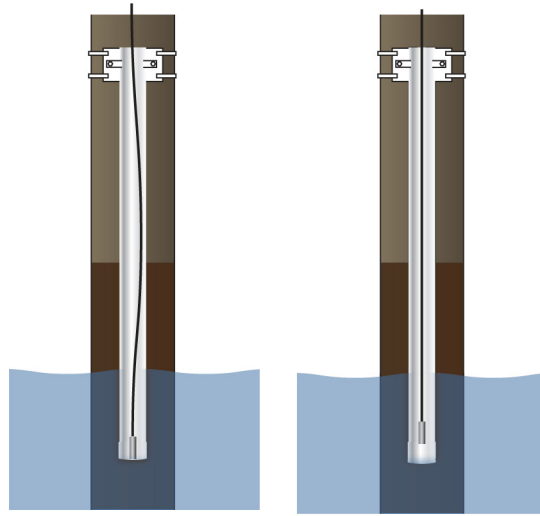
When installing the pressure sensor, be careful not to bump the sensor. Any rough handling can result in inaccurate readings and change the sensor gain.

Complete the following steps to install the pressure sensor:

1. Gently lower the pressure sensor into the stilling well.

If the well is capped, lower the cable until it goes slack (sensor touches bottom of stilling well) and raise the sensor about 2 inches (5 cm) until the sensor cable goes tight.

If the stilling well is not capped, measure the cable first and mark it so that the sensor will hang about 2 inches (5 cm) inside the bottom of the well.



2. Secure the sensor cable to the top of the stilling well so the cable is centered in the well and does not move vertically.

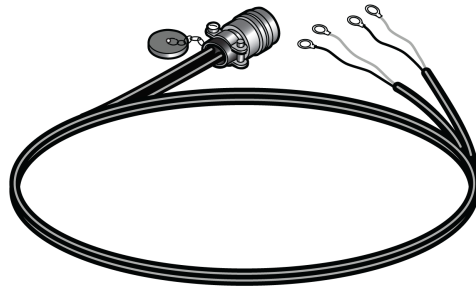
Note: For long-term installations, fasten the sensor to the bottom of the stilling well to eliminate vertical sensor movement. Use any durable, flexible material. Make sure water flow is not restricted to the end of the sensor.

3. Connect the connector at the end of the pressure sensor cable to the receiver on the Base Station.

Base Station

This section describes how to connect the cables, power up, and configure the Base Station.

Connect the Power Cable



The Base Station uses a power cable that has both solar power and battery/power supply connectors. Connect the power cable as follows:

1. Make sure all power switches are in the **OFF** position on both the Base Station and the power supply, if applicable.
2. Connect the twist lock connector to the receiver on the Base Station.
3. Connect the black lead to the negative terminal of the battery or power supply.
4. Connect the white lead to the positive terminal of the battery or power supply.
5. **Optional:** Connect the solar panel using the same procedure: black lead to the negative terminal, white lead to the positive terminal.

Connect the Antenna

The antenna uses a Type N Connector Cable Assembly.



Both ends are identical. Connect one end to the antenna and the other end to the Type-N Connector socket on the Base Station.

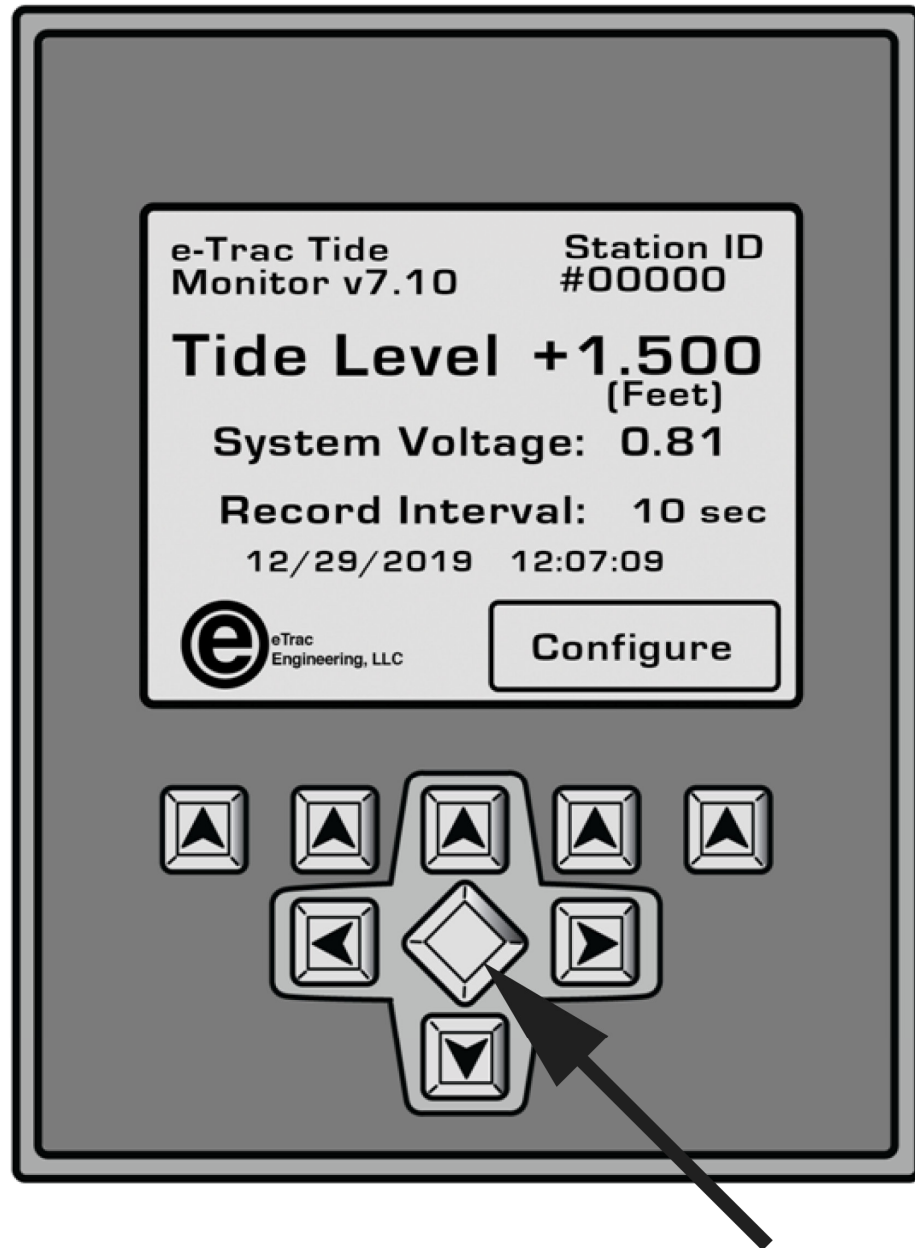
Power Up the Base Station

Make sure the power cable and antenna are connected. Power up the Tide Gauge by moving the **ON / OFF** toggle switch to **ON**.

Wait approximately six seconds for the screen to display. If there is no input for 30 seconds, the backlight will turn off to conserve power. Continue to the next section for more information about configuring the Base Station.

Configure the Base Station

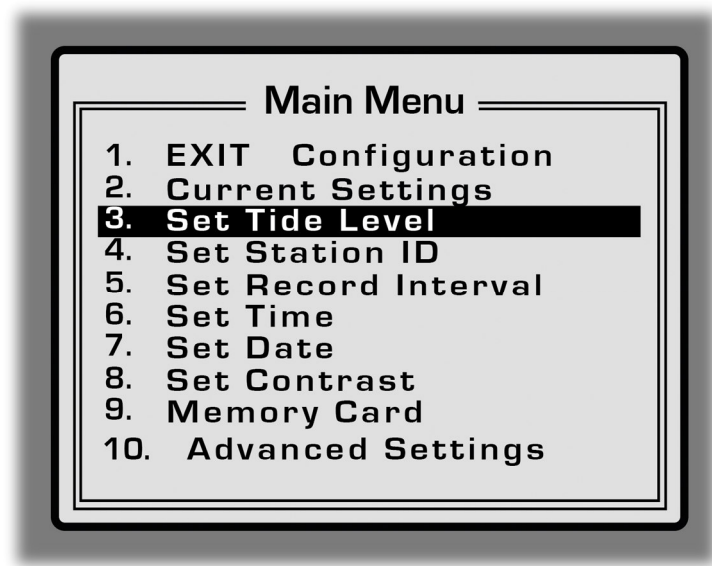
The TideTrac Tide Gauge Base Station can be configured using the touchscreen and the navigation softkeys below the touchscreen.



Enter Key

1. Press **Configure** on the touchscreen.

The **Main Menu** screen displays.



2. Use the **Up** and **Down** arrow to highlight a configuration option. Press the diamond-shaped **Enter** to select the highlighted option.
3. Continue to the appropriate section.

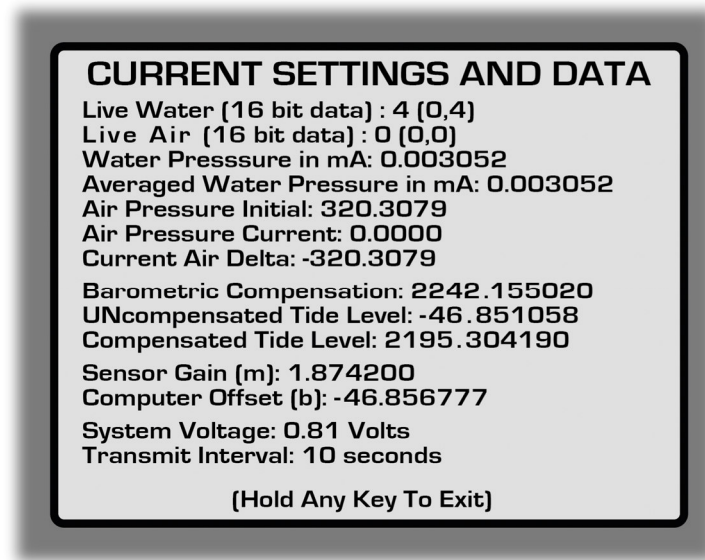
Note: You can press **[ESC]** from most screens to return to the **Main Menu**.

View the Current Settings

Current settings provide a detailed view of system settings and data that affect tide readings.

1. From the **Main Menu**, highlight **Current Settings** and press the **Enter** key.

The **Current Settings and Data** screen displays.



2. Press and hold any key to return to the **Main Menu**.

Set the Present Tide Level

A current tide level is needed to ensure accurate logging of tide changes.

1. From the **Main Menu**, highlight **Set Tide Level** and press the **Enter** softkey.

The **Set Tide Level** screen displays.



The image shows a touchscreen interface for entering a tide level. At the top, there is a label 'Enter Tide Level' above a large empty rectangular input field. Below the input field is a numeric keypad with four rows of buttons. The first row contains buttons for digits 7, 8, and 9, followed by an 'ESC' button. The second row contains buttons for digits 4, 5, and 6, followed by a 'CLR' button. The third row contains buttons for digits 1, 2, and 3, followed by a 'DEL' button. The fourth row contains buttons for digits 0, a decimal point '.', a hyphen/underscore '-', and a 'RET' button.

2. Using the touchscreen, enter the present tide level in feet. For example, 2.5 equals two feet six inches.
3. Press **[RET]** to save the tide level and return to the **Main Menu**.

Change the Station ID

A Base Station and Remote Unit must have the same Station ID to communicate. The Base Station ID is preconfigured to match the Remote Unit Station ID, if purchased together. The Station ID can be changed if needed. If you have multiple TideTrac Tide Gauges deployed in the same proximity, the Station ID must be unique for each Tide Gauge Base Station.

1. From the **Main Menu**, highlight **Change Station ID** and press the **Enter** key.

The **Enter Station ID** screen displays.



2. Enter the Base Station ID. It can be any number between 1 and 99.
3. Press **[RET]** to save the Station ID and return to the **Main Menu**.

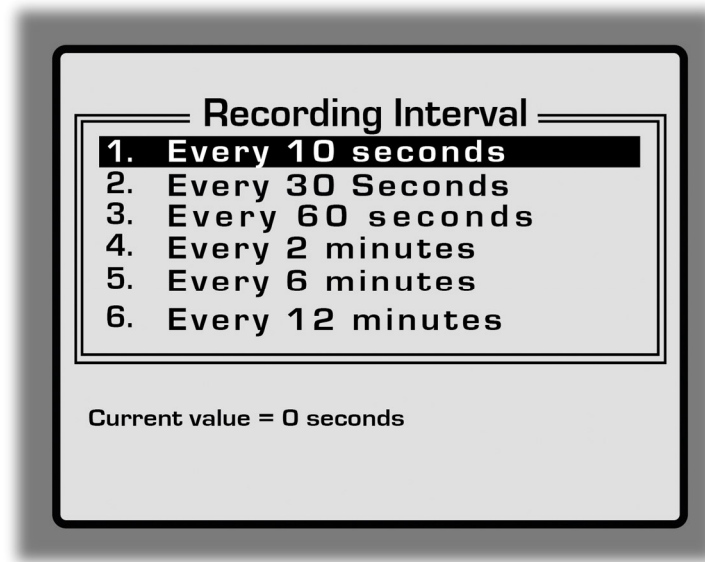
Note: If TideTrac was purchased with a Remote Unit, the Station ID is preconfigured and should not be changed.

Set the Recording Interval

The Recording Interval controls how often tide information is recorded to the internal memory card.

1. From the **Main Menu**, highlight **Set Record Interval** and press the **Enter** key.

The **Recording Interval** screen displays.



2. Using the **Up** and **Down** arrow keys, select the appropriate Recording Interval.
3. Press the **Enter** key to save the Recording Interval and return to the **Main Menu**.

Set the Time

Time setup is needed to allow for time zone changes. The time is stored on the internal memory card.

1. From the **Main Menu**, highlight **Set Time** and press the **Enter** key.

The **Enter New Time** screen displays.



The screenshot shows a screen titled "ENTER NEW TIME <HHMMSS>" with an example "e.g. 13:25:00 is 132500". Below the title is a large display showing the value "132500". At the bottom is a numeric keypad with buttons for digits 0-9, a decimal point, a minus sign, and function keys: ESC, CLR, DEL, and RET.


2. Using the touchscreen, enter the time in 24-hour format, using HHMMSS. For example, **132500** is the equivalent of 13:25:00.
3. Press **[RET]** to save the time and return to the **Main Menu**.

Set the Date

Date configuration is necessary for initial setup. The date is stored on the memory card.

1. From the **Main Menu**, highlight **Set Date** and press the **Enter** key.

The **Enter New Date** screen displays.



The screenshot shows a screen titled "ENTER NEW DATE" with a prompt "<MMDDYYYY>". Below the prompt, the date "01012010" is displayed. At the bottom of the screen is a numeric keypad with the following layout:

7	8	9	ESC
4	5	6	CLR
1	2	3	DEL
0	.	-	RET

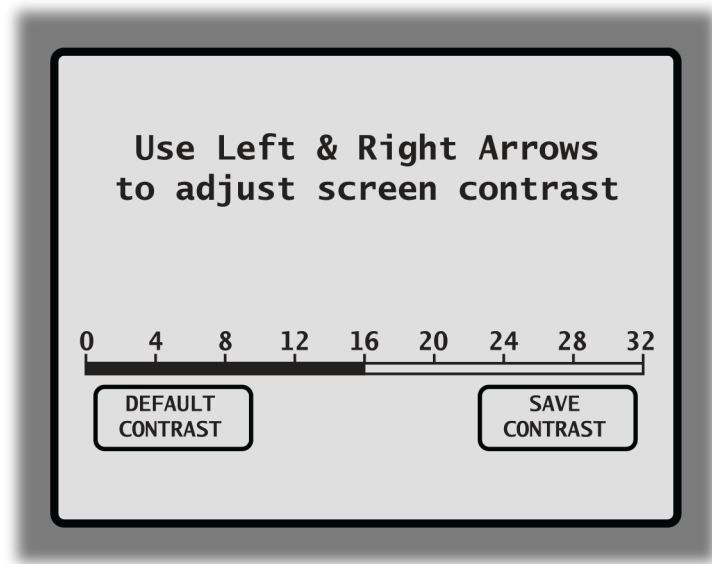
2. Enter the date, using MMDDYYYY format. For example, **01012010** is the equivalent of 1/1/2010.
3. Press **[RET]** to save the date and return to the **Main Menu**.

Set the Touchscreen Contrast

You can adjust the brightness of the backlight for the touchscreen.

1. From the **Main Menu**, highlight **Set Contrast** and press the **Enter** key.

The **Contrast** screen displays.



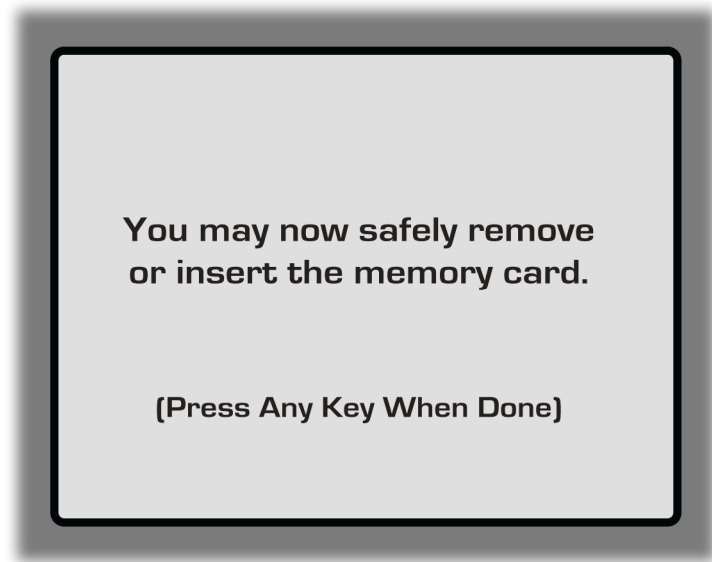
2. Use the **Left** and **Right** arrow keys to set the contrast level. The range is from 0 (darkest) to 32 (brightest).
3. To reset the default contrast level, press the far left **Up** arrow soft key under the **Default Contrast** button.
4. To save the new contrast level, press the far right **Up** arrow soft key under the **Save Contrast** button. The system saves the contrast setting and returns to the **Main Menu**.

Remove or Insert the Memory Card

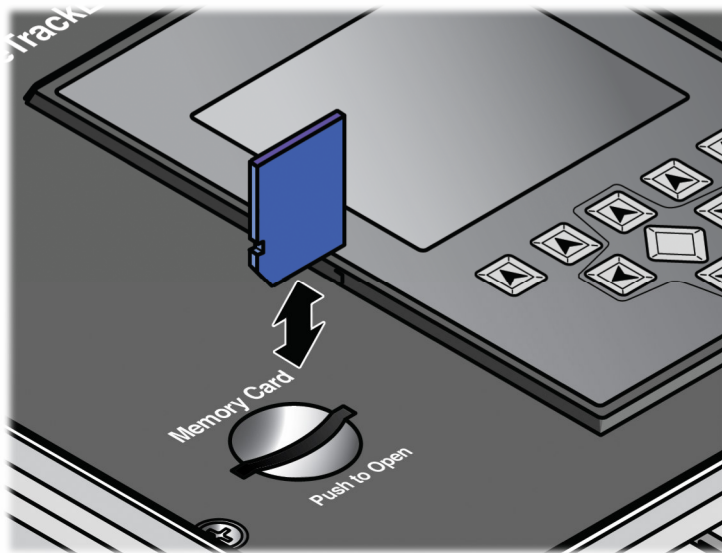
Use this command to pause data logging and safely remove or insert the memory card.

1. From the **Main Menu**, highlight **Memory Card** and press the **Enter** key.

The **Memory Card** screen displays.



2. Remove or insert the memory card.



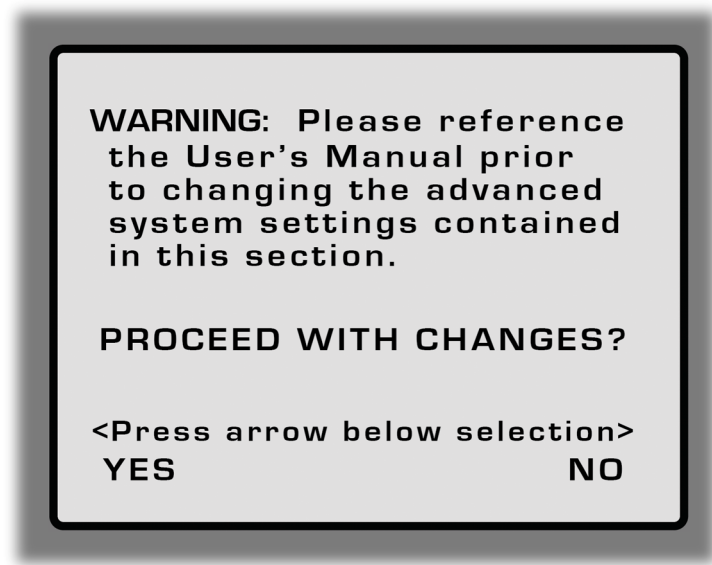
3. Press any key to return to the **Main Menu**.

View the Advanced Settings

Use Advanced Settings to configure tide data averaging, adjust pressure sensor gain, activate/deactivate radio transmission, and toggle between English and Metric units.

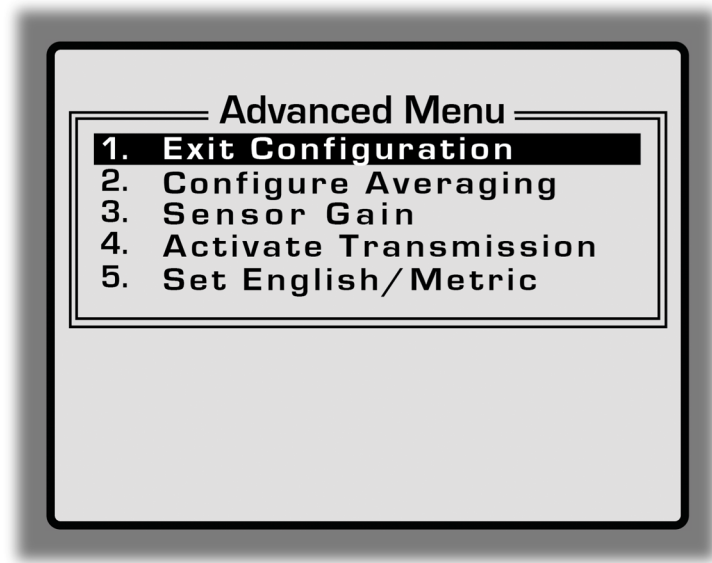
1. From the **Main Menu**, highlight **Advanced Settings** and press the **Enter** key.

The Warning screen displays.



2. To exit without making any changes and return to the **Main Menu**, press the far right **Up** arrow soft key under the **NO** selection.

3. To continue, press the far left **Up Arrow** softkey under the word **YES**.



4. When done working with advanced settings, highlight **Exit Configuration** and press the **Enter** key to return to the **Main Menu**.

Configure Averaging

In areas of high localized “noise” such as vessel wake, averaging reduces such effects to the data displayed and recorded on the memory card.

The averaging options available to the user are None, Light, Moderate, Standard, Heavy, and Maximum. These work by combining a weighted percentage of the most recently sampled sensor value with a running average of previous sample history. For example, Standard averaging computes a tide level that is 85% the most recently read sample and 15% the running average value. The table below illustrates the percentage weights for each of the 6 averaging values.

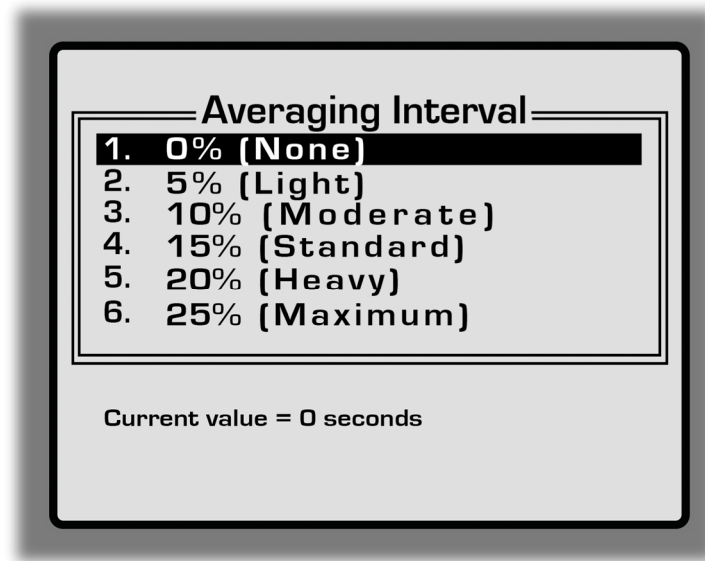
Options	Description
None	100% of the most recent sensor reading, 0% of the running average value.
Light	95% of the most recent sensor reading, 5% of the running average value.
Moderate	90% of the most recent sensor reading, 10% of the running average value.
Standard	85% of the most recent sensor reading, 15% of the running average value.
Heavy	80% of the most recent sensor reading, 20% of the running average value.
Maximum	75% of the most recent sensor reading, 25% of the running average value.

When you select and save an averaging weight (Light, Standard, Heavy, etc.), that level of averaging is saved in permanent memory and remains in effect until you select and save a different averaging weight.

Complete the following procedure to configure averaging:

1. From the **Advanced Menu**, highlight **Configure Averaging** and press the **Enter** key.

The **Averaging Interval** screen displays.



2. Using the **Up** and **Down** arrow keys, select the appropriate averaging interval. Press the **Enter** key to select the highlighted option and return to the **Main Menu**.

Set the Sensor Gain

The sensor gain must be entered correctly to ensure accurate tide level readings.

1. From the **Main Menu**, highlight **Set Sensor Gain** and press the **Enter** key.

If the sensor gain has been previously configured, the **Underwater Pressure Sensor Gain** screen displays.



2. Read the warning. To exit and return to the **Main Menu** screen, press the far right **Up** arrow key under the **NO** selection.

OR

To continue setting the sensor gain, press the far left **Up** arrow under the word **YES** selection.

If the sensor gain has not been previously configured, the **Enter Sensor Gain** screen displays.



Enter Sensor Gain (ft)
e.g. 1.8733 is 18733

7 8 9 ESC
4 5 6 CLR
1 2 3 DEL
0 . - RET

3. Enter the five-digit gain setting as listed on the pressure sensor cable. **Do not enter any decimal points.** When you enter five digits, the system automatically enters the decimal point.
4. Press **[RET]** to save the sensor gain and return to the **Main Menu**.

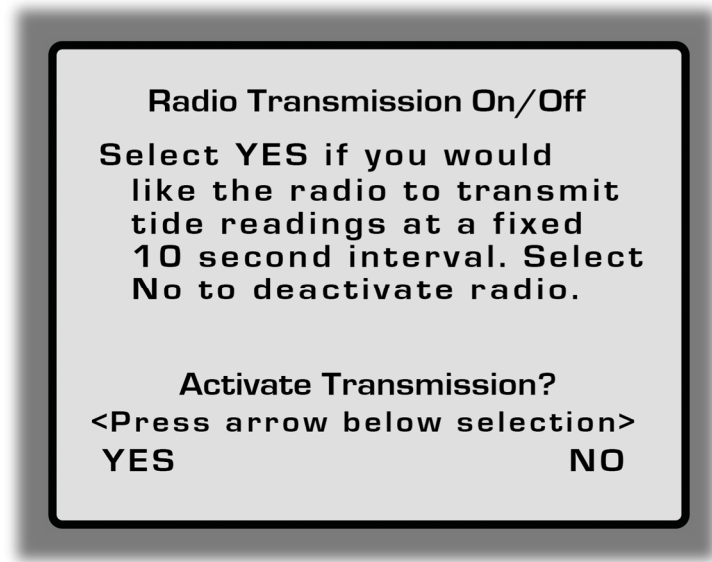
Note: Sensor Gain must be reset after changing units from English to Metric or Metric to English.

Activate or Deactivate Radio Transmission

Radio transmission from the TideTrac Base Unit may be turned on or off. Turning the transmission off reduces power consumption of the unit.

1. From the **Advanced Menu**, highlight **Activate Transmission** and press the **Enter** key.

The **Radio Transmission On/Off** screen displays.



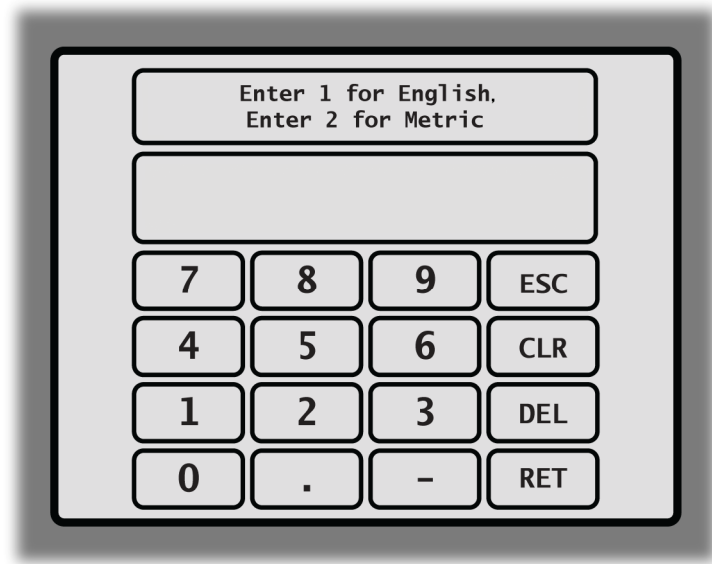
2. To activate radio transmission every 10 seconds and return to the **Main Menu**, press the far left **Up** arrow under the word **YES**.
3. To deactivate radio transmission and return to the **Main Menu**, press the far right **Up** arrow under the word **NO** selection.

Set Measurement Units to English or Metric

Use this configuration setting to switch between English and Metric measurement units.

1. From the **Main Menu**, highlight **English/Metric** and press the **Enter** key.

The **English/Metric** screen displays.



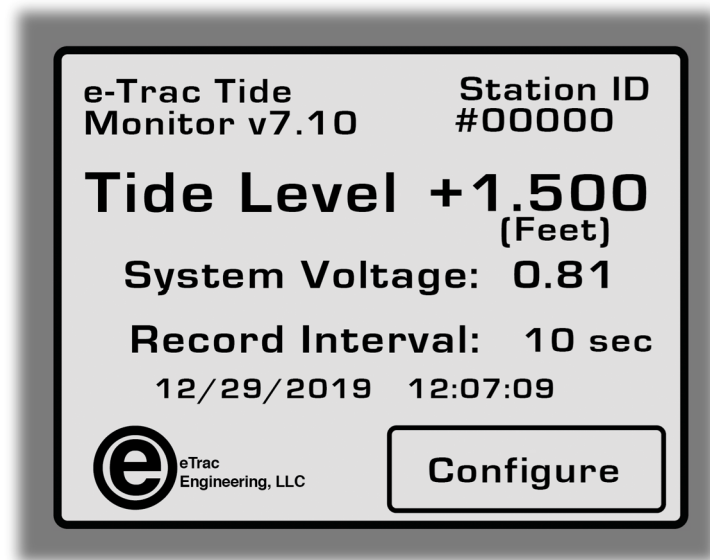
2. Enter **1** for English. Enter **2** for Metric.
3. Press **[RET]** to save the measurement units and return to the **Main Menu**.

Note: Sensor Gain must be reset after changing units from English to Metric or Metric to English.

Exit Configuration

From the **Main Menu**, highlight **Exit Configuration** and press the **Enter** softkey.

The screen returns to the default display.

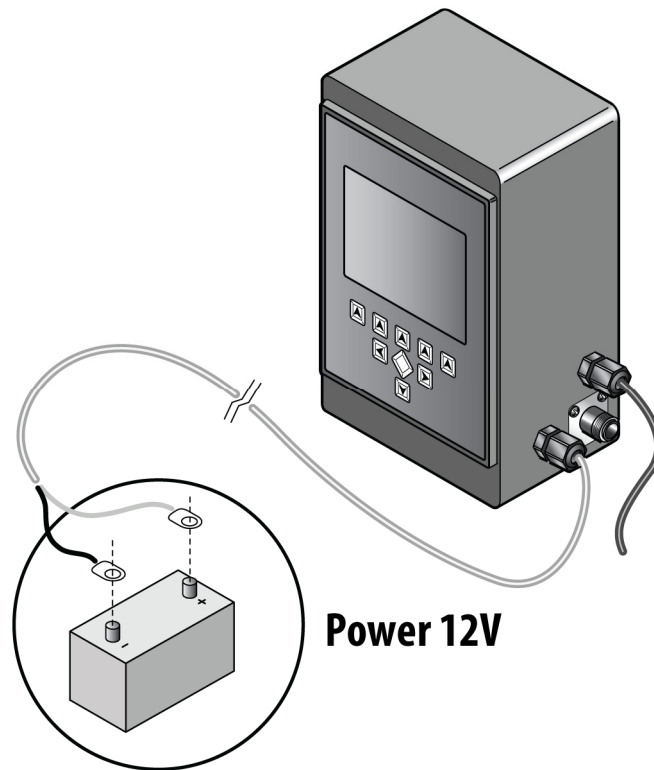


Remote Unit

This section describes how to connect the cables, power up, and configure the Remote Unit.

Connect the Power Cable

The Remote Unit has an attached power cable that can connect to a 12 Volt battery or power supply.

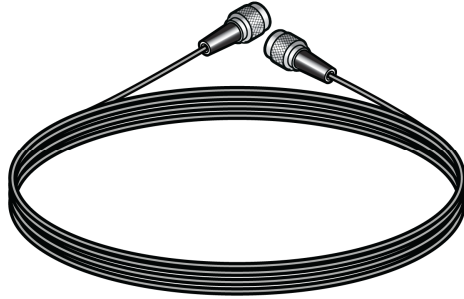


Connect the power cable as follows:

1. Make sure the power switch is in the **OFF** position on both the Remote Unit and the power supply, if applicable.
2. Connect the black lead to the negative terminal of the battery or power supply.
3. Connect the white lead to the positive terminal of the battery or power supply.

Connect the Antenna

The antenna uses a Type N Connector Cable Assembly.



Both ends are identical. Connect one end to the antenna and the other end to the Type-N Connector socket on the Remote Unit.

Power Up the Remote Unit

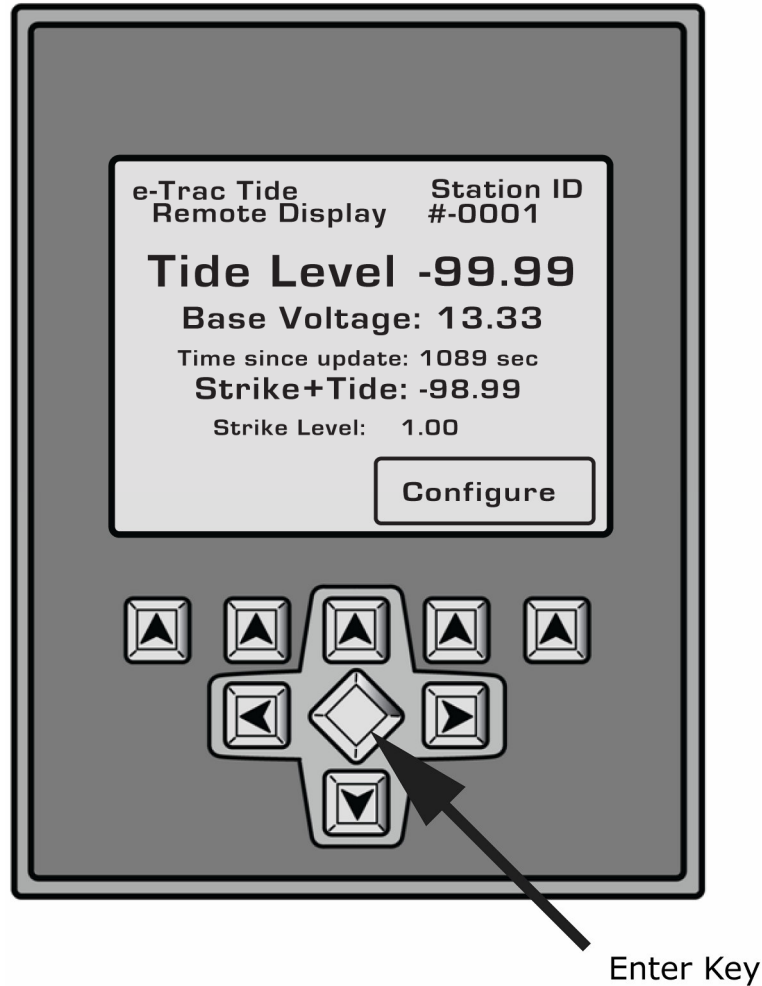
Make sure the power cable and antenna are connected. Power up the Remote Unit by moving the **ON / OFF** toggle switch to **ON** (forward).

Wait approximately six seconds for the screen to display. If there is no input for 30 seconds, the backlight will turn off to conserve power.

The Remote Unit touchscreen shows the Station ID, current tide level, system voltage, transmit interval, date, and time.

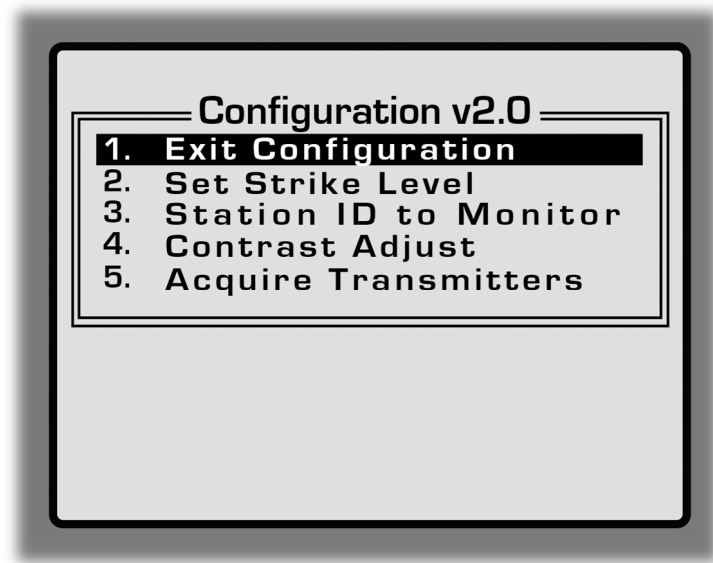
Tide Gauge Remote Unit Touchscreen

The TideTrac Tide Gauge Remote Unit is configured using the touchscreen on the display itself and the navigation softkeys below the touchscreen.



Configure the Remote Unit

1. Press **Configure** on the touchscreen.
The **Configuration** screen displays.



2. Use the **Up** and **Down** arrow keys to highlight a configuration option. Press the diamond-shaped **Enter** key to select the highlighted option.
3. Continue to the appropriate section.

Note: You can press **[ESC]** from most screens to return to the **Configuration** screen.

Enter the Strike Level

The strike level is the user-defined depth minus the tide level.

Note: Set the strike level for dredging purposes only.

1. From the **Configuration** menu, highlight **Set Strike Level** and press the **Enter** softkey.

The **Enter Strike Level** screen displays.



2. Using the touchscreen, enter the strike level in feet (for example, 42).
3. Press **[RET]** to save the strike level and return to the **Configuration** screen.

Select the Station ID

A Base Station and Remote Unit must have the same Station ID to communicate. The Base Station ID is preconfigured to match the Remote Unit Station ID, if purchased together. The Station ID can be changed if needed.

To view the Station IDs of Base Stations within range, see the [Acquire Transmitters](#) section.

1. From the **Configuration** menu, highlight **Change Station ID** and press the **Enter** key.

The **Enter Station ID** screen displays.



2. Enter the Station ID equal to the TideTrac Base Station ID you wish to receive a transmission from. It can be any number between 1 and 99.
3. Press **[RET]** to save the Station ID and return to the **Configuration** screen.

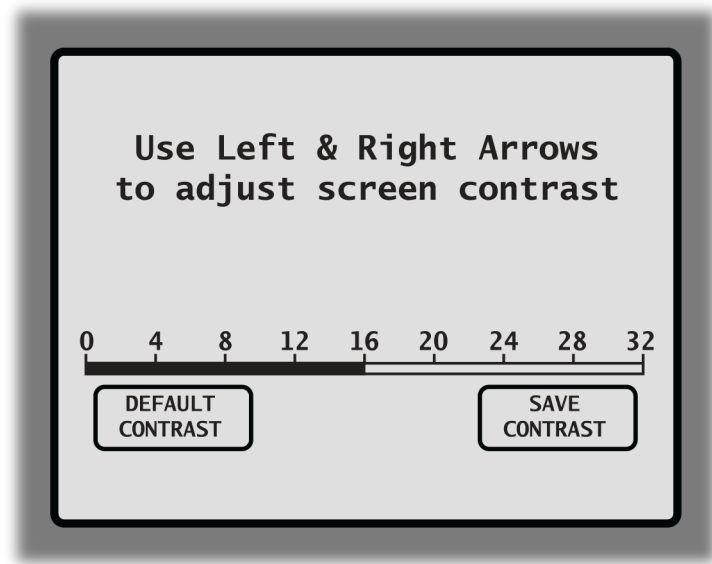
Note: If TideTrac was purchased with a Remote Unit, the Station ID is preconfigured and should not be changed.

Adjust the Touchscreen Contrast

You can adjust the brightness of the backlight for the touchscreen.

1. From the **Configuration** menu, highlight **Contrast Adjust** and press the **Enter** key.

The **Contrast** screen displays.



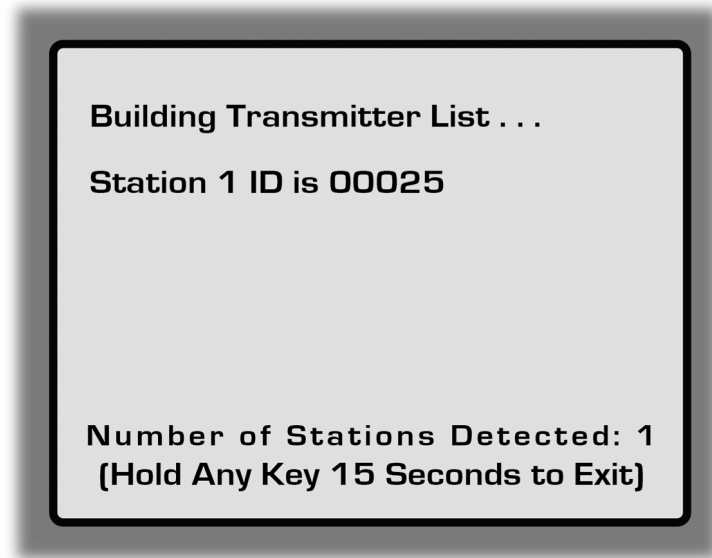
2. Use the **Left** and **Right** arrow keys to set the contrast level. The range is from 0 (darkest) to 32 (brightest).
3. To reset the default contrast level, press the far left **Up** arrow soft key under the **Default Contrast** button.
4. To save the new contrast level, press the far right **Up** arrow soft key under the **Save Contrast** button. The system saves the contrast setting and returns to the **Configuration** screen.

Acquire Transmitters

You can find the Station ID of all active Base Station units within range. You need to know the Base Station ID to configure the Remote Unit to communicate with the Base Station using the same Station ID.

1. From the **Configuration** menu, highlight **Acquire Transmitters** and press the **Enter** key.

The **Building Transmitter List** screen displays.

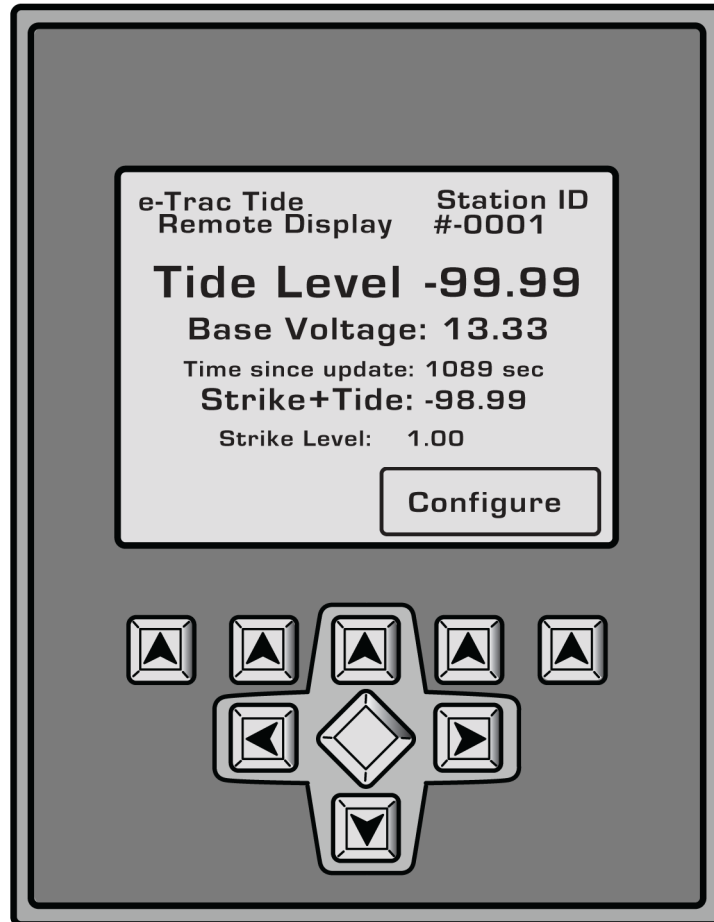


2. Wait for the Remote Unit to build the Transmitter List.
3. Record the number of the Station ID you want to use to configure the Remote Unit.
4. Press and hold any key to exit the **Build Transmitter List** screen.

See Select the Station ID to configure the Station ID of the Remote Unit.

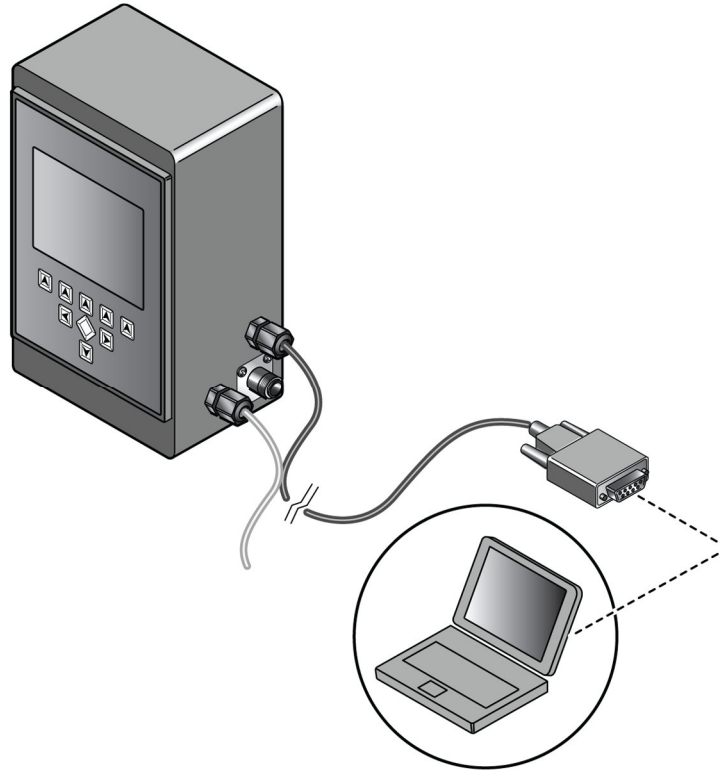
Check the Base Station Voltage Level

The Base Station voltage level is displayed on the remote as **Base Voltage**.



View the Transmit Log

Use a desktop or laptop computer to connect to the Remote Unit using the serial cable.



You can view or record the tide level log data as it is received at the Remote Unit.

Connect a desktop or laptop computer using the serial cable.

Use a Telnet program such as HyperTerminal to establish a connection using the following settings:

Baud Rate	9600
Data Bits	8
Parity	None
Stop Bits	1
Flow Control	None

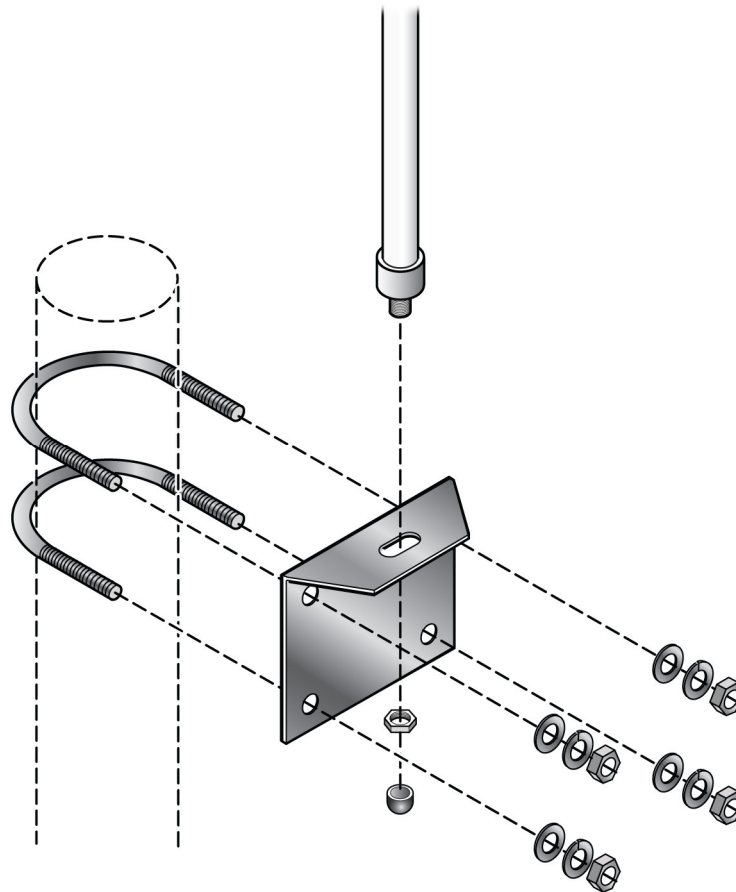
Antenna

Attach each Omni antenna to a stable manufactured base or mast, according to the manufacturer's specification.

The standard Omni antenna should be oriented vertically. The optional Yagi antenna should be oriented horizontally.

Note: For maximum range, each antenna should be mounted as high as is safely possible.

The following illustration shows a standard antenna, mounted vertically and attached to a mast:



TideTrac Day-to-Day Use

This section describes tasks that you can complete on a daily basis.

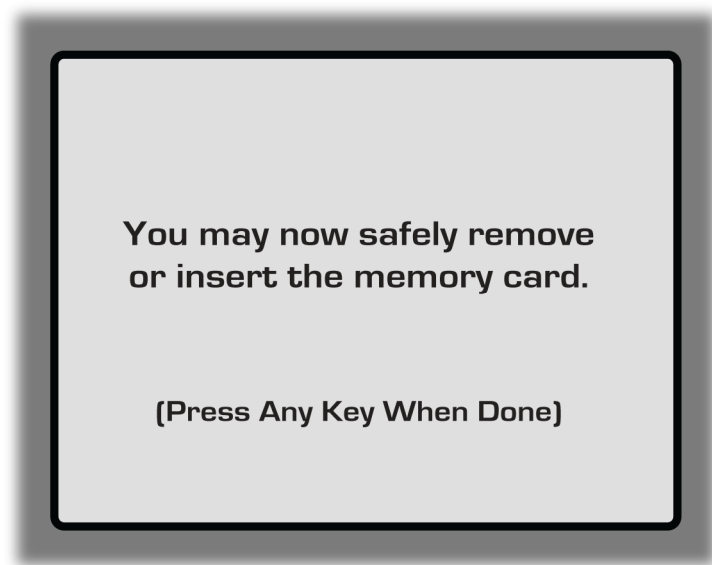
Download Logged Data

The TideTrac Tide Gauge keeps a log file of tide data. Access to this data is available from the removable SD Media Card in the Base Station.

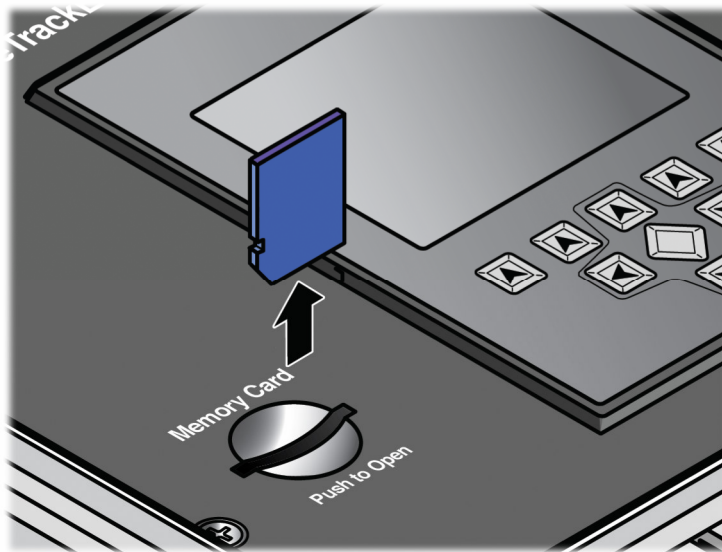
Complete the following steps to eject the card and download the log file:

1. From the default screen, press **Configuration**.
2. Highlight **Memory Card** and press the **Enter** key.

The **Memory Card** screen displays.



3. Press down on the card and release it to eject.



4. Using a card reader or the memory card slot in your laptop, download the **datalog.txt** file.
5. When you are done downloading the file, insert the memory card into the memory card slot and press any softkey to continue.

Maintain Contact between the Base Station and the Remote Unit

To maintain the best signal between the Base Station and the Remote Unit, consider the following recommendations:

- For best range, maintain line-of-sight between antennas.
- Areas with power lines and electromagnetic (EMF) interference will reduce radio range and can cause incomplete data strings.
- Tide data can be retrieved from the memory card in scenarios where the wireless connection cannot be maintained, such as obstacle interference or EMF interference.

FAQs

If you have any performance or operational issues, refer to the following list of frequently asked questions (FAQs):

Must the pressure sensor be mounted in a stilling well?

For best performance, protection, and sensor life, a stilling well is recommended. In calmer water installations, the sensor can be mounted along a fixed object below the low water line, but caution must be taken to not damage the sensor during mounting.

The Remote Unit tide level reading is 99.99. Why?

The Remote Unit automatically updates the tide level when it receives a reading from the Base Station. If the reading is 99.99, the Remote Unit has not received a signal from the Base Station.

- Check the range between the base and remote. They may be too far apart.
- Check for obstacles possibly blocking your signal.
- Check the antenna connections at both the base and remote.
- Make sure that the Base Station has power.

At the previous job location, the Base Station and Remote Units had an excellent signal at a range of over 4 miles. At the new job location, there is no signal at half a mile. What has changed?

The wireless telemetry of the system can vary from site to site based on obstacles, electromagnetic (EMF) interference line-of-sight, antenna location, and antenna height.

Using a different antenna style or gauge location will often improve the range, even in challenging areas.

How can I check my shore-side power supply to know that a battery change might be needed?

The Remote Unit receives a regularly updated voltage reading, displayed as **Remote Voltage**. When that value falls below 10 Volts, it is recommended that a new battery be installed. The solar option can significantly extend battery life depending on the level of available sunlight.

I have entered my present tide reading and it has not changed. Was something entered incorrectly?

Re-enter the gain value, which can be found near the connector of the pressure sensor. The gain value is entered without a decimal point (for example, 1.8777 = 18777).

Glossary

Base Station

The TideTrac Tide Gauge system's major component, housed in a waterproof and crush-proof case. The Base Station consists of a computer, radio transceiver, removable memory, and internally sealed NEMA 4 connectors with waterproof end-caps.

MLLW (Mean Lower Low Water)

The average of the lower low-water height of each tidal day observed over the National Tidal Datum Epoch.

NEMA 4 Standard

The connectors meet the National Electrical Manufacturers Association (NEMA) 4 standard, which states: Enclosures constructed for either indoor or outdoor use to provide a degree of protection against falling dirt, rain, sleet, snow, windblown dust, splashing water, and hose-directed water; and that will be undamaged by the external formation of ice on the enclosure.

Pressure Sensor

The submersible component of the Tide Gauge. The pressure sensor communicates changes in water pressure to the Base Station.

Remote Unit

A small portable radio transceiver that communicates with the Base Station. The Remote Unit displays tide updates and battery voltage level information. It can output tide data to a computer for data recording or for integration with software.

Serial Cable

A standard DB-9 (9-pin) serial cable connects the Remote Unit to a computer to output tide data for integration with software or data recording.

Stilling Well

A vertical pipe, made of PVC or other durable material, that can be vented from the top and bottom to provide an isolated environment for the Tide Gauge pressure sensor.

Type N Connector Cable Assembly

A threaded RF connector used to join coaxial cables. The Tide Gauge uses Type-N Connector Cable Assemblies for all antenna applications.

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